Endangered Species Act - Section 7 Consultation

SUPPLEMENTAL BIOLOGICAL OPINION

Operation of the Federal Columbia River Power System
Including the Juvenile Fish Transportation Program:
A Supplement to the Biological Opinions Signed
on March 2, 1995, and May 14, 1998, For the Same Projects

Agencies: U.S. Army Corps of Engineers
Bonneville Power Administration
Bureau of Reclamation
National Marine Fisheries Service

Consultation Conducted by: National Marine Fisheries Service
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I. OBJECTIVES

This is an interagency consultation pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) and implementing regulations found at 50 CFR Part 402. The Federal agencies that operate or market power from the Federal Columbia River Power System (FCRPS), namely the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (Corps), and the U.S. Bureau of Reclamation (BoR) (collectively "the Action Agencies"), consulted with the National Marine Fisheries Service (NMFS) concerning the effects of the FCRPS on three listed species of Snake River salmon during 1995. The NMFS concluded the 1995 consultation with a biological opinion and reasonable and prudent alternative (RPA) entitled "Reinitiation of Consultation on the 1994-1998 Operation of the FCRPS and Juvenile Transportation Program in 1995 and Future Years" issued on March 2, 1995 (hereafter referred to as the 1995 FCRPS Biological Opinion or the 1995 RPA). With the new anadromous fish ESA listings in 1998, 1995 RPA was supplemented to consider the effects of FCRPS operations on Snake River, Upper Columbia River, and Lower Columbia River steelhead (<u>Oncorhynchus</u> <u>mykiss</u>). The NMFS concluded the 1998 consultation with a supplement to the 1995 FCRPS Biological Opinion entitled "Supplemental Biological Opinion: Operation of the Federal Columbia River Power System Including the Smolt Monitoring Program and the Juvenile Fish Transportation Program. A Further Supplement to the Biological Opinion Signed on March 2, 1995, For the Same Projects."

The Action Agencies have again reinitiated consultation to consider the effects of the FCRPS on six species listed during 1999:

- Upper Columbia River (UCR) spring chinook salmon (listed as endangered on March 24, 1999 [64 FR 14308]);

- Lower Columbia River (LCR) chinook salmon (listed as threatened on March 24, 1999 [64 FR 14308]);

- Middle Columbia River (MCR) steelhead (listed as threatened on March 25, 1999 [64 FR 14517]);

- Upper Willamette River (UWR) spring chinook salmon (listed as threatened on March 24, 1999 [64 FR 14308]); and

- Upper Willamette River (UWR) steelhead (listed as threatened on March 25, 1999 [64 FR 14517]).

- Columbia River (CR) chum salmon (listed as threatened on March 25, 1999 [64 FR 14508]).

The objective of this consultation is to determine whether the operation of the FCRPS, as proposed by the Action Agencies and described in Section III (below) is likely to jeopardize the continued existence of any of the newly-listed species or is likely to destroy or adversely modify designated critical habitat. Although critical habitat has not yet been designated, NMFS has proposed the following as critical habitat for each of these species:

- UCR spring chinook salmon – all river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington (63 FR 11482);

- LCR chinook salmon – all river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the White Salmon River in Washington and the Hood River in Oregon (inclusive; 63 FR 11482);

- MCR steelhead – all river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Yakima River in Washington (64 FR 5740);

- UWR chinook salmon and UWR steelhead – all river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon (63 FR 11482 for chinook salmon and 64 FR 5740 for steelhead); and

- CR chum salmon – all river reaches and estuarine areas accessible to listed chum salmon in the Columbia River downstream from Bonneville Dam (63 FR 11774).

This biological opinion supplements the 1995 FCRPS Biological Opinion and the 1998 Supplemental FCRPS Biological Opinion. Although neither of these opinions specified an expiration date, NMFS intended that they remain in effect until replaced in a subsequent consultation and biological opinion regarding the long-term operation and configuration of the FCRPS. Therefore, both the 1995 biological opinion and the 1998 supplemental opinion, including the 1995 RPA and the 1995 and 1998 incidental take statements, shall continue in full effect, as supplemented by this 2000 supplemental biological opinion, until they are superceded by the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999. Neither the proposed action nor the incidental take statement in this 2000 Supplemental FCRPS Biological Opinion nullify any reasonable and prudent measures, proposed actions, or terms and conditions of the 1995 and 1998 supplemental biological opinions.

II. BACKGROUND

The NMFS proposed six additional species of anadromous Columbia basin salmonids for ESA listing on February 25, 1998. In a letter to W. Stelle (NMFS) and T. Dwyer (U.S. Fish and Wildlife Service [USFWS]) dated April 7, 1998, R. Griffin (Corps) stated that the Action Agencies (U.S. Army Corps of Engineers [Corps], the U.S. Bureau of Reclamation [BoR], and Bonneville Power Administration [BPA]), based on data known at that time, did not believe that the measures being considered in consultation for Snake River, Upper Columbia River, or Lower Columbia River steelhead would be likely to jeopardize any of the proposed species. He requested that if either NMFS or the USFWS had scientific information then, or in the future, that indicated otherwise, they share this information with the Action Agencies.

Stelle responded in a letter addressed to Griffin, J. Keys (BoR), and J. Robertson (BPA) dated June 1, 1998. Stelle noted that the Action Agencies' letter contained no discussion of effects of the proposed action on these species and referenced no reports or assessments that contained that information. Thus, NMFS could not evaluate the basis for the Action Agencies' conclusion regarding effects of the FCRPS operations on these species. Stelle suggested that it would benefit all of the Federal agencies to conduct an ESA conference and to document the conclusions through a conference report. The Action Agencies acknowledged receipt of this recommendation in a letter from Griffin to Stelle dated August 10, 1998. However, Griffin stated that the purpose of the April 7, 1998, letter was to ask NMFS to confirm that the FCRPS actions being considered in the steelhead consultation would not jeopardize the species proposed for listing, or to share with the Action Agencies any data which NMFS was aware of at that time which would indicate otherwise. Griffin repeated his request in the August 10 letter. Finally, Stelle replied in a letter addressed to Griffin, S. Clark (BoR), and J. Johansen (BPA) that, at that time, NMFS had no information or analyses to indicate that the Action Agencies' operation of the FCRPS was jeopardizing proposed species. However, Stelle noted that the situation could change as more information was obtained regarding the biological requirements of proposed species and as specific actions were proposed by the Action Agencies. Further, Stelle stated that the Action Agencies' proposal to coordinate operations through existing forums would not obviate the need for consultation if the proposed listings were made final.

In a letter to Stelle dated May 20, 1999, and signed by E. Mogren (Corps), the Action Agencies requested consultation with NMFS on the effects of the FCRPS on UCR spring chinook salmon, LCR chinook salmon, and MCR steelhead during the remainder of the interim period, from the date this biological opinion is signed until it is superceded by the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999. That consultation is intended to consider the long-term configuration and operation of the FCRPS to address the biological needs of these species. Mogren noted that the NMFS and the Corps were engaged in a separate consultation on the UWR chinook salmon and UWR steelhead ESUs that considered their full life-cycle status and biological requirements.

The NMFS replied to the Action Agencies on June 23, 1999 (Brown to Mogren), that their consultation package was complete. The NMFS recommended that the requirements of all six of the newly listed species be addressed in formal consultation, leading to a supplemental biological opinion during the rest of the interim period. However, the NMFS quickly recognized that an operation for Columbia River chum salmon would include consideration of issues beyond those on which it had previously consulted. The NMFS began meeting with the regional fish and wildlife managers (Oregon Department of Fish and Wildlife [ODFW], Washington Department of Fish and Wildlife [WDFW], U.S. Fish and Wildlife Service [USFWS], and Columbia River Intertribal Fish Commission [CRITFC]) on July 1, 1999, to discuss results of the 1998 pilot study pertinent to the biological requirements of this ESU. The NMFS continued to meet with the comanagers through mid-October; the Action Agencies engaged in these meetings beginning in August, exchanging technical information to enable development of an operation and an in-season process that would provide spawning habitat for chum salmon in the mainstem without impairing either the operations specified in the 1995 and 1998 Biological Opinions or the ability of parties to comply with the Vernita Bar agreement (Section III.A.2).

III. PROPOSED ACTION

III.A. Operation of the FCRPS by the Action Agencies (Corps, BPA, and BoR)

The Action Agencies have proposed an interim action consisting of three parts, continuing the interim operation recommended by NMFS for the previously listed species, implementing flow management to support chum salmon spawning below Bonneville Dam, and ensuring that methods to assess critical uncertainties regarding the significance of effects of the FCRPS on UCR spring chinook salmon, LCR chinook salmon, UWR chinook salmon, MCR steelhead, UWR steelhead, and CR chum salmon, in the context of the full life cycle, are developed and applied.

III.A.1. Interim Operation of the FCRPS

The Action Agencies propose to implement the reasonable and prudent alternative (RPA) described in NMFS' 1995 FCRPS Biological Opinion; as adopted in their Records of Decision; as subsequently modified through the November 14, 1996, Framework letter from W. Stelle (NMFS) to B. Bohn (Corps) and in the 1998 Supplemental FCRPS Biological Opinion; and as further modified in this supplemental biological opinion to support spawning by ESA-listed salmonids in the Ives Island area (Hardy and Hamilton creeks and Hamilton Slough) below Bonneville Dam.

III.A.2. Flow Management to Support Columbia River Chum Salmon Spawning in the Ives Island Area Below Bonneville Dam

Interim Operation for Chum Salmon Spawning in the Ives Island Area Below Bonneville Dam

Based on the information developed by NMFS for the 1997 chum salmon status review (Johnson et al. 1997; Section IV.A.6) and through the collaborative meetings described in Section II, the Action Agencies propose to implement, for the interim period covered by this supplemental biological opinion, operation of the FCRPS to support chum salmon spawning in shallow mainstem areas around Ives and Pierce islands and access to Hardy and Hamilton creeks. The operation will be implemented as described below if the best hydrologic data available by mid-September indicate that precipitation, runoff, and reservoir storage are likely to support the operation from the start of spawning (late October or early November) until the end of emergence (generally through the start of the spring flow augmentation season in April)[1] without adverse effect on implementation of the 1995 RPA, the 1998 supplemental biological opinion, or the ability of parties to comply with the Vernita Bar agreement (see Reservoir Refill Hydroregulation Study, below)[2]. If these conditions cannot be met, the Action

[1] A few individuals can be captured as late as June (USFWS, unpublished data).

[2] The FCRPS is currently operated under the terms set forth in the 1995 RPA and 1998 supplemental biological opinion to meet the flow objectives at McNary Dam for the protection of listed salmon. The flow objective for McNary Dam is 220 to 260 kcfs from April 20 through June 30. Thus, beginning April 20 in most water years, flows downstream from Bonneville Dam would routinely be substantially larger than the

Agencies will work with NMFS to identify operations that would provide benefits to chum salmon while maintaining existing fish protection measures (i.e., 1995 RPA, 1998 supplemental biological opinion, and Vernita Bar agreement).

Real-time decision-making concerning this operation will be accomplished through the in-season process established in the 1995 RPA (the Technical Management Team of the Regional Forum). The TMT will recommend a managed daily average discharge level on a weekly basis (or as needed) as information on natural flows and reservoir storage becomes available. Specifically, the operation for CR chum salmon will include the following considerations:

1. If the operation is feasible (as described above), it will begin when field researchers sight chum salmon in the area around Ives and Pierce islands, but no later than November 1st. Based on recommendations developed by NMFS from information provided by the regional fish and wildlife managers (Table III-1), the Action Agencies propose to manage FCRPS storage with natural flow to achieve a 125 kcfs average daily discharge ("managed daily average discharge") ± 5 kcfs from Bonneville Dam from November 1 through December 31.[3] Specifically, for a managed daily average discharge of 125 kcfs, the instantaneous discharge will range from a minimum of 120 kcfs to 130 kcfs.

   The NMFS recognizes that access to spawning habitat in the Ives Island area is primarily a function of the water surface elevation in the Ives and Pierce islands area. Water surface elevation, in turn, is influenced by tides and the flow (stage) of the Willamette River as well as the discharge rate from Bonneville Dam. In the event that the established managed daily average discharge cannot be maintained on an instantaneous basis (e.g., during a low "spring" tide), the Action Agencies propose to maintain the water surface elevation in the Ives Island area above the highest redd established by the operation.

2. When reservoir storage, baseflows, and predicted hydrologic conditions permit (see Reservoir Refill Hydroregulation Study, below), a higher managed daily average discharge may be adopted. The TMT will recommend the actual managed daily average discharge (i.e., 125 kcfs or higher). The Action Agencies will manage storage with natural flow to provide that discharge ± 5 kcfs. If storage and predicted hydrologic conditions do not permit a higher discharge level, the

operations described in this supplemental biological opinion.

[3] The hydraulic connection between Hamilton Slough (between the Washington shoreline and Ives and Pierce islands) and the mainstem Columbia River and the areal extent of submerged spawning gravels are strongly affected by FCRPS water management. According to USFWS, ODFW, and WDFW field biologists, a discharge of 125 kcfs is needed to create and sustain the connections and to provide the minimal extent of habitat, with additional flow needed to counteract a drop in river elevation during the lower low of a spring tidal cycle. Creation and maintenance of these hydraulic connections provide access for adults to spawning areas, prevent dewatering of redds during incubation, and provide an emigration route for juveniles after emergence.

instantaneous minimum discharge level will remain 120 kcfs (i.e., 125 kcfs minus 5 kcfs).

3. At managed daily average flows of 160 kcfs or higher, the Action Agencies will provide an instantaneous minimum discharge of 155 kcfs (i.e., 160 kcfs minus 5 kcfs) at Bonneville Dam, with a day average of at least 160 kcfs. In this case, the maximum instantaneous discharge would not be limited.

4. During incubation and emergence (January 1 through the start of the spring flow augmentation program for the lower Columbia River on April 20[4]), the Action Agencies will manage storage with natural flows to maintain the daily average discharge from Bonneville Dam needed to protect the highest redd established by the operation and to maintain connectivity between spawning habitat and the mainstem for outmigrants. For example, if storage is managed such that the daily average Bonneville outflow is between 125 kcfs and 134 kcfs during spawning, a discharge of at least 125 kcfs will be maintained through incubation and emergence. For all managed spawning flows 135 kcfs and above, the highest spawning flow minus 10 kcfs will be the managed daily average discharge during incubation and emergence. The highest managed daily average discharge that will be provided during the incubation and emergence period is 150 kcfs.

If inseason data on reservoir elevations and forecasted inflow indicate that the operation specified in the 1995 RPA and 1998 supplemental biological opinion cannot be achieved by providing these flows during incubation and emergence, the instantaneous minimum Bonneville outflow will be reduced as necessary to achieve the biological opinion requirements and/or so as not to impair the ability of parties to comply with the Vernita Bar agreement. The Action Agencies will ensure that flow reductions are coordinated through the Technical Management Team of the Regional Forum to ensure that adverse effects are minimized and to facilitate the development of emergency actions.

As described above, the extent to which the interim operation can provide spawning habitat in the Ives Island area for CR chum salmon without adverse effect on implementation of the 1995 RPA, the 1998 supplemental biological opinion, or the Vernita Bar agreement will vary between water years. In NMFS' 1995 RPA, the Action Agencies were required to identify and provide additional volumes of water for flow augmentation from the upper Snake River and Canada. This requirement continues in full effect during the rest of the interim period.

[4] Although the emergence period for CR chum salmon continues through May, the Action Agencies' proposed action in this 2000 supplemental biological opinion will be implemented through April 20. On that date, the requirement to meet the spring flow objective at McNary Dam begins, as described in the 1995 RPA: "When the January-July volume runoff forecast for The Dalles is >85 MAF and #105 MAF, the average spring flow shall be determined by a linear interpolation between 220 kcfs and 260 kcfs. When the January-July runoff forecast for The Dalles is >105 MAF, the target average spring flow at McNary will be at least 260 kcfs (1995 RPA)." Hence, in terms of a daily average Bonneville discharge, the requirements of the 1998 biological opinion are expected to provide adequate protection for emerging juveniles after April 20.

Reservoir Refill Hydroregulation Study

A reservoir refill study shows the predicted range of effects for an operation proposed for a specific, relatively near-term time period. The Action Agencies propose to perform, by September 15th of each year, a 60-year reservoir-refill hydroregulation study to predict the effects of the interim operation for Columbia River chum salmon on other biological opinion and Vernita Bar operations. The study will include a minimum instantaneous discharge case (125 kcfs) and at least two alternative operations with incrementally higher discharge levels. Starting dates for each case will vary to show the relative risks and impacts. The purpose of the hydroregulation modeling is to identify the risks associated with undertaking a given level of chum habitat protection downstream from Bonneville Dam. Of particular concern is the ability to meet Lake Roosevelt's (Grand Coulee Dam) refill target and to provide other fish protection benefits. The constraints of the model will be defined annually in consultation with NMFS.

Results will be presented in a form that shows the effects of each flow alternative on the following parameters: (1) the Bonneville flow request, (2) Grand Coulee refill to upper rule curve by April 15[5], (3) the Vernita Bar flow requirement, and (4) daily average inflows to Wanapum Project exceeding 100 kcfs (assumes 70 kcfs during daytime) during the fall spawning period. The Action Agencies will provide the study results to TMT by September 15th of each year. The TMT will use this information to develop the recommended operation to support chum salmon spawning in the Ives Island area.

III.B. Analytical Techniques and Data for Consultation on the Long-term Configuration and Operation of the FCRPS

Because the effects of the proposed action on newly-listed species are uncertain, the Action Agencies are participating in comprehensive analyses of the effects of the FCRPS on their biological requirements. The development of these analytical techniques and the data that will be gathered and analyzed is important for assessing the species-level biological requirements and the effects of the FCRPS on these species in the long term. This work is intended to provide scientific data and analyses that are not now available for the species considered in this opinion but will be important for reaching the determinations required by ESA Section 7(a)(2) during the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

III.B.1. Upper Columbia River Spring Chinook Salmon

Per the Action Agencies' proposal in the 1998 supplemental biological opinion, they are currently

[5] The 1995 RPA states a requirement to refill Grand Coulee to upper rule curve by April 10th. However, April 15th is the end date used by the HydroSim model, which considers water management during two periods in April.

ensuring development of analytical tools for a comprehensive analysis of the effects of a proposed long-term FCRPS action on the biological requirements of UCR spring chinook salmon. These analyses are being coordinated with the regional fish and wildlife managers and are a component of the mid-Columbia Quantitative Analytical Report (QAR) process. The QAR process, proposed in the 1998 Supplemental FCRPS Biological Opinion and described in Toole and Hevlin (1999), was designed to support the ESA Section 7(a)(2) determination of whether the proposed long-term action is likely to jeopardize listed species originating from this subregion during the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

III.B.2. Lower Columbia River Chinook Salmon

The LCR chinook salmon spawning aggregation in the Ives Island area may represent an important component of the genetic and life-history diversity of the ESU. However, at present, considerable uncertainty exists about the relationship of chinook salmon spawning naturally in the Ives Island area to population structure. The genetic data for LCR chinook salmon analyzed for NMFS' status review (Myers et al. 1998) indicated that the fish sampled from several LCR tributaries formed a coherent cluster within the Columbia River basin. However, no samples from chinook salmon spawning in the mainstem below Bonneville Dam were available at that time. The WDFW collected samples from tule chinook salmon in the Ives Island area this fall, but the sample size was small and probably not sufficient to accurately relate mainstem spawners below Bonneville Dam to the ESU population structure. So that the Action Agencies will have sufficient information to ensure that any proposed long-term operation for the FCRPS will satisfy their Section 7(a)(2) obligations, they propose to secure additional genetic sampling of tule fall chinook salmon spawning in tributaries in Bonneville pool and below Bonneville Dam, as well as the Ives Island area. The Action Agencies will ensure that these data, which will contribute to their ability (in consultation with NMFS) to determine the contribution of these spawners to the viability of the ESU, are obtained by funding and participating in these studies. They will seek concurrence from NMFS, through the Regional Forum process, regarding the specific study methods and entities to be contracted for collection and genetic analysis of LCR chinook salmon specimens. The Action Agencies will complete scoping and will develop a proposal by June 30, 2000.

III.B.3. Middle Columbia River Steelhead

No research has been performed to date on the survival of MCR steelhead through the FCRPS. In terms of evaluating the effects of the proposed action in Section VI of this supplemental biological opinion, NMFS relied on data obtained for UCR and SR steelhead. Given the large degree of overlap in rearing characteristics and run-timing among these three ESUs, the NMFS indicated during consultation that this technique would be adequate for assessing the effects of the proposed interim action. However, during consultation, NMFS also informed the Action Agencies that information specific to the effects of the proposed interim action on MCR steelhead, in the context of the species-level biological requirements (i.e., over the species full life history), will be critical to determining the appropriate long-term operation of the FCRPS to ensure the survival and recovery. Therefore, so that the Action Agencies will have sufficient information to ensure that any proposed long-term operation for the FCRPS will satisfy their Section 7(a)(2) obligations, they propose to develop and analyze time series of index population abundances and smolt-to-adult return rates (SARs) for MCR steelhead. The Action Agencies will ensure that these data are obtained by funding and participating in these studies, seeking concurrence from NMFS, through the Regional Forum process, regarding the specific study methods and entities to be contracted. The Action Agencies will complete scoping and will develop a proposal by June 30, 2000.

III.B.4. Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead

The majority of the effects of FCRPS operations on the biological requirements of UWR chinook and UWR steelhead are assumed to be associated with the 13 federal hydro projects on the Willamette River and its tributaries. The Corps is addressing these effects in a <u>separate</u> ESA Section 7 consultation with NMFS. However, as is also true of the other four species of salmonids discussed in this supplemental biological opinion, the biological requirements of UWR chinook salmon and UWR steelhead are affected by FCRPS water management in the lower Columbia River below Bonneville Dam, the estuary, the plume, and the nearshore ocean environment. These effects are the subject of ongoing BPA-funded research by NMFS' Northwest Fisheries Science Center (NWFSC). In particular, information on the survival of smolts through the estuary under various flow regimes and the relationship between FCRPS flow management and saltwater intrusion will help NMFS determine the appropriate long-term operation to ensure that the biological requirements of juvenile UWR chinook salmon and steelhead are met. Because these studies are ongoing, the Action Agencies do not propose any additional research with respect to these ESUs at this time.

III.B.5. Columbia River Chum Salmon

During consultation, NMFS informed the Action Agencies that currently available information will not be sufficient for determining whether any proposed long-term operation of the FCRPS will ensure the survival and recovery of CR chum salmon. The NMFS informed the Action Agencies during consultation that it will be necessary to evaluate the contribution of the Ives Island spawning aggregation to the viability of the CR chum salmon ESU (using the Viable Salmonid Population [VSP] guidelines currently being developed) in order to resolve critical uncertainties. The NMFS anticipates using six types of information to determine whether the Ives Island spawners constitute an independent population:

- Genetic differentiation (allele frequencies);
- Environmental and habitat characteristics (e.g., substrate type, groundwater influence);
- Life history and morphological traits (e.g., run timing);
- Correlations in abundances (e.g., peak counts, escapement);
- Estimates of the proportion of individuals in one aggregation that originated from another aggregation ("rate of exchange between spawning aggregations"); and
- Geographic distribution.

The first four parameters are the subject of ongoing study by ODFW, WDFW, and USFWS. However, the last two, rates of exchange between spawning aggregations and geographic distribution, have not been the subject of study to date or have not been adequately evaluated.

Rates of exchange between spawning aggregations are determined by marking juveniles trapped at the time of emergence or adults that have returned to the area. As a rule-of-thumb, if the inferred rate of gene flow from another population within the ESU (e.g., Hardy or Hamilton creek) to the Ives Island population is greater than 10% to 25%, the populations are likely to be considered demographically connected (NMFS 1999a). Ongoing adult radio-tracking studies by USFWS, although designed to respond to a different set of objectives, may provide information on the feasibility of evaluating rates of exchange between spawning aggregations using this technique.

Our understanding of the current geographic distribution and spatial dynamics of spawning aggregations of CR chum salmon is incomplete. Fulton (1970) identified 24 historical chum salmon spawning areas in the Columbia River basin. Kostow (1995) cited reports of 23 spawning areas in Oregon tributaries. However, at the present time, spawning populations of CR chum salmon are recognized only on the Washington side of the Columbia River, in Grays River, Hardy and Hamilton creeks, and Ives Island (index areas). The WDFW found chum salmon in nine out of 21 streams sampled during their 1998 surveys of non-index spawning areas (Keller 1999). Small numbers of redds (less than four per survey) were found in four of these creeks along the Washington shoreline (i.e., Elochoman, Abernathy, Germany, and St. Cloud creeks; WDFW, unpublished data). However, funding for non-index area surveys was discontinued after the 1998 field season. Unless support is renewed, the only available information will be incidental reports of spawning outside the index areas. Neither the timing or year-to-year consistency of spawning that has been reported in the lower reaches of the Cowlitz River and near the I-205 bridge, nor the destination of adult chum salmon passing Bonneville Dam, for example, will be documented. Additionally, the current extent of spawning in Oregon tributaries is unknown because that state does not conduct field surveys during the peak period for chum salmon spawning.

During consultation, NMFS informed the Action Agencies that these two types of information will be critical to determining the appropriate long-term operation of the FCRPS to ensure the survival and recovery of CR chum salmon. So that the Action Agencies will have sufficient information to ensure that any proposed long-term operation for the FCRPS will satisfy their Section 7(a)(2) obligations, they propose to estimate rates of exchange between the Hardy and Hamilton creek and Ives Island spawning aggregations and numbers of chum salmon spawning in Oregon and Washington tributaries below The Dalles Dam. The spawning surveys will be more extensive (in terms of geographic coverage and level of effort) than those currently performed and will provide information needed by NMFS to determine the importance of the Ives Island spawners to the population structure of the ESU. They will also provide preliminary information regarding chum salmon spawning habitat quality in lower river tributaries and opportunities for habitat restoration. The Action Agencies will ensure that these data are obtained by funding and participating in these studies, seeking concurrence from NMFS, through the Regional Forum process, regarding the specific study methods and entities to be contracted. The Action Agencies will complete scoping and will develop a proposal by June 30, 2000.

The NMFS informed the Action Agencies during consultation that a third type of information will be critical to long-term decision making for CR chum salmon. So that the Action Agencies will have sufficient information to ensure that any proposed long-term operation for the FCRPS will satisfy their Section 7(a)(2) obligations, they propose to study the feasibility (including both biological benefits and ecological risks) of habitat modification to improve spawning conditions for chum (and chinook) salmon in the Ives Island area. The objectives of the study will be to determine whether it would be beneficial to increase the frequency of access to spawning habitat or the areal extent of spawning habitat by means other than flow augmentation. The feasibility study will evaluate actions to alter the hydraulic control points that limit flow in the Ives Island area to provide the same areal extent and quality of spawning habitat (including characteristics such as upwelling through the gravels, currently present at the site) at lower levels of Bonneville discharge; reconstruct spawning channels to increase the extent of habitat available at a given level of Bonneville discharge; and maintain hydraulic connections between tributary habitats and the mainstem Columbia River to allow entry for adults and emergence channels for juveniles. The feasibility study will also consider institutional issues of property ownership and land uses designations; the likelihood that modified habitat would withstand high flows (e.g., under mainstem and local tributary flood conditions); maintenance, rehabilitation, and removal costs; and potential adverse effects on existing fish and wildlife habitat. The Action Agencies will ensure that these data are obtained by funding and participating in these studies, seeking concurrence from NMFS, through the Regional Forum process, regarding the specific study methods and entities to be contracted. The Action Agencies will complete scoping and will develop a proposal by June 30, 2000.

IV. BIOLOGICAL INFORMATION

IV.A. List of Species: Life Histories, Factors for Decline, and Current Range-Wide Status

Unless otherwise stated, the information in the following sections is taken from the respective status reviews and Federal Register listing notices for each of the species:

- UCR spring chinook salmon, LCR chinook salmon, UWR chinook salmon – Myers et al. 1998 and 64 FR 14308;
- MCR steelhead and UWR steelhead – Busby et al. 1996 and 64 FR 14517; and
- CR chum salmon – Johnson et al. 1997 and 64 FR 14508.

IV.A.1. Upper Columbia River (UCR) Spring Chinook Salmon

The UCR spring chinook salmon ESU includes all progeny of naturally-spawning populations of stream-type (spring) chinook salmon in all river reaches above Rock Island Dam and downstream of Chief Joseph Dam, excluding the Okanogan River. Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Chiwawa River (spring run); Methow River (spring run); Twisp River (spring run); Chewuch River (spring run); White River (spring run); and Nason Creek (spring run). Life history characteristics of UCR spring chinook salmon have been reviewed by Chapman et al. (1994) and Myers et al. (1998). The NMFS listed the UCR spring chinook salmon ESU as endangered on March 24, 1999 (64 FR 14308).

<u>Factors for Decline</u>

Development of the hydrosystem has substantially affected the UCR spring chinook ESU. Important spawning and rearing habitat was blocked due to the construction of Grand Coulee Dam, and juvenile and adult migration is impacted by up to nine downstream dams and upstream reservoir storage operations. Degradation of the remaining spawning and rearing habitat has contributed to the decline of spring chinook in the upper Columbia River basin. Risks associated with artificial production programs within the ESU are a concern because of the use of a composite, non-native Carson Hatchery stock for fishery enhancement and hydrosystem mitigation. There is now an effort underway to develop locally-adapted broodstocks to supplement the natural populations in the ESU. Ocean harvest rates are very low and instream harvest rates are moderate for this ESU. Current harvest rates have been on a downward trend. For example, from 1978 through 1993 ocean harvest was estimated at 0.6%.

Current Range-Wide Status

Recent total abundance of UCR spring chinook has been quite low; 1994 through 1996 escapements were the lowest in the last 60 years. Some naturally-spawning populations have become extinct and those remaining have fewer than 100 spawners (Myers et al. 1998). Overall, run estimates have been variable but show a declining trend, especially in recent years.

Captive broodstock programs are under way in Nason Creek and White River in the Wenatchee basin, in the Twisp River in the Methow basin to prevent those populations from going extinct. In 1998, all spring chinook were trapped at Wells Dam to begin an adult-based composite broodstock supplementation program for the Methow basin. Fish are released into the mid-Columbia River region from Leavenworth, Entiat, and Winthrop National Fish Hatcheries and Methow, Ringold, and Chiwawa River hatcheries.

IV.A.2. Lower Columbia River (LCR) Chinook Salmon

The LCR chinook salmon ESU includes all progeny of naturally-spawning populations of both spring- and fall-run chinook salmon in tributaries to the Columbia River from a transition point located east of the Hood River, Oregon, and the White Salmon River, Washington, to the mouth of the Columbia River at the Pacific Ocean and in the Willamette River below Willamette Falls, Oregon (excluding spring chinook salmon in the Clackamas River). The ESU includes the progeny of naturally-spawning tule-type fall chinook salmon observed spawning in the Ives Island area during the first few weeks of October 1999. Life history characteristics of LCR chinook salmon have been reviewed by Myers et al. (1998). The NMFS listed the LCR chinook salmon ESU as threatened on March 24, 1999 (64 FR 14308).

Factors for Decline

All subbasins in the range of this ESU are affected (to varying degrees) by habitat degradation. Major habitat problems are related primarily to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agriculture in floodplains and low-gradient tributaries. Substantial chinook salmon spawning habitat has been blocked (or passage substantially impaired) in the Cowlitz (Mayfield Dam 1963, RKm 84), Lewis (Merwin Dam 1931, RKm 31), Clackamas (North Fork Dam 1958, RKm 50), Hood (Powerdale Dam 1929, RKm 7), and Sandy (Marmot Dam 1912, RKm 48; Bull Run River dams in the early 1900s) rivers (WDF et al. 1993, Kostow 1995).

Apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally-spawned populations. Hatchery programs to enhance chinook salmon fisheries in the lower Columbia River began in the 1870s, expanded rapidly, and have continued through this century. Although the majority of the stocks have come from within this ESU, over 200 million fish from outside the ESU have been released since 1930. Since 1960, most natural-run fall chinook spawning on the Oregon side of the lower Columbia River has been attributed to hatchery strays (Olsen 1992). In fact, hatchery straying, along with habitat degradation, overharvest, and competition from hatchery juveniles, has been identified as one of the major problems facing naturally-spawning fall-run chinook salmon in Oregon's lower river tributaries (Kostow 1995). Available evidence indicates that there has also been a pervasive influence of hatchery fish on spring-run populations (Howell et al. 1985, Marshall et al. 1995).

Harvest rates on fall-run spawning populations have been moderately high, with an average total exploitation rate of 65% for the 1982 through 1989 brood years (PSC 1994). The freshwater harvest rate on the fall run has averaged 20%, ranging from 30% in 1991 to 2.4% in 1994. Harvest rates are somewhat lower for spring-run stocks, with estimates for the Lewis River averaging 24% ocean and 50% total exploitation rates in 1982 through 1989 (PSC 1994) Inriver fisheries harvest approximately 15% of the lower river hatchery stock, 29% of the lower river wild stock, and 58% of the Spring Creek hatchery stocks (PFMC 1996). The average inriver exploitation rate on the ESU as a whole averaged 29% during 1991 through 1995.

Current Range-Wide Status

There are no reliable estimates of the historical abundance of LCR chinook salmon, but it is generally agreed that natural production has been substantially reduced over the last century. Long- and short-term trends in abundance of individual populations are mostly negative, some severely so. About half of the populations comprising this ESU are very small, increasing their vulnerability to genetic and demographic risks.

The numbers of naturally-spawning spring-run chinook are especially low (a 5-year geometric mean of 11,200 fish); the pervasive influence of hatchery fish in almost every river in this ESU and the degradation of freshwater habitat suggests that many naturally-spawning spring-run populations are not able to replace themselves. At least six extinctions of spawning populations have been documented and additional extirpations may have been masked by the presence of naturally-spawning hatchery fish. For example, native populations in the Sandy and Clackamas Rivers have been supplanted by spring-run fish from the upper Willamette River. The remaining spring-run spawning populations in this ESU are found in the Sandy, Lewis, Cowlitz, and Kalama Rivers (spring-run chinook salmon in the Clackamas River are included in the UWR ESU). Recent abundance estimates also include a fall run of approximately 29,000 natural spawners and 37,000 hatchery spawners (1991 through 1995). However, according to the accounting of the PFMC (1996), approximately 68% of the natural spawners are first-generation hatchery strays.

IV.A.3. Middle Columbia River (MCR) Steelhead

The MCR steelhead ESU includes all progeny of naturally-spawning steelhead in streams from above the Wind River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington. This ESU includes the only populations of winter inland steelhead in the

United States (in the Klickitat River, Washington, and Fifteenmile Creek, Oregon, Busby et al. 1996). The NMFS listed the MCR steelhead ESU as threatened on March 25, 1999 (64 FR 14517).

Factors for Decline

Hatchery fish are widespread and stray to spawn naturally throughout the region. Recent estimates of the proportion of natural spawners of hatchery origin range from "low" (in the Yakima, Walla Walla, and John Day rivers) to "moderate" (Umatilla and Deschutes rivers). In addition, the factors contributing to the decline of this ESU include agricultural practices, especially grazing and water diversions and withdrawals. Hydrosystem development has affected the ESU through loss of spawning and rearing habitat above hydrosystem projects, changes in runoff patterns due to upstream reservoir operations, and mortalities associated with migration through the Columbia River hydrosystem.

Current Range-Wide Status

Within the MCR steelhead ESU, the Yakima, Umatilla, and Deschutes spawning populations have shown an overall upward trend, although trends in all tributaries to the Deschutes River are downward and trends in the Yakima River are recovering from extremely low levels in the early 1980s. The John Day River probably represents the largest native, natural-spawning population in the ESU but combined spawner surveys for that population have been declining at a rate of about 15% per year since 1985 (Busby et al. 1996). The NMFS, in proposing this ESU for listing as threatened under the ESA, cited low returns to the Yakima River, poor abundance estimates for Klickitat River and Fifteenmile Creek winter steelhead, and an overall decline for naturally-producing spawning populations within the ESU.

IV.A.4. Upper Willamette River (UWR) Chinook Salmon

The UWR chinook salmon ESU includes all progeny of naturally-spawning populations of spring-run chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Life history characteristics of UWR chinook salmon have been reviewed by Myers et al. (1998). The NMFS listed the UWR chinook salmon ESU as threatened on March 24, 1999 (64 FR 14308).

Factors for Decline

Habitat loss and degradation have contributed to the decline of spring chinook in the Willamette basin. Many of the key production areas in the basin have been blocked by the construction of dams. Channelization and the loss of complex side channel and wetland habitat have reduced the amount of rearing habitat in the mainstem Willamette River. Alterations to temperature and flow regimes may result in the premature emergence of juveniles (during lower flows periods) and thus may result in lower juvenile survival rates. Large artificial production programs have probably contributed to the loss of genetic diversity among natural populations from hatchery fish straying into natural production areas.

Historical harvest rates ranged from 50% to 70%, apparently higher than wild spawning populations could sustain.

Current Range-Wide Status

The abundance of naturally-produced spring chinook in the UWR chinook salmon ESU has declined substantially. From 1946 through 1950, the geometric mean of spring chinook spawner counts at Willamette Falls was 31,000 fish (Myers et al. 1998), primarily naturally-produced fish. The most recent 5-year (1992 through 1996) geometric mean escapement above the falls was 26,000 fish, comprised primarily of hatchery-produced fish. For natural populations in the ESU where data exist, Myers et al. (1998) reported strong short-term negative trends (a decline of more than 7%) in spring chinook salmon abundance. It is questionable whether natural production within the Willamette basin is self-sustaining, even in the absence of fisheries (Meyers et al. 1998).

VI.A.5. Upper Willamette River (UWR) Steelhead

The UWR steelhead ESU includes all progeny of naturally-spawning winter-run steelhead in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River, inclusive. Life-history characteristics of UWR steelhead have been reviewed by Busby et al. (1996). The NMFS listed the UWR steelhead ESU as threatened on March 25, 1999 (64 FR 14517).

Factors for Decline

Steelhead native to the UWR ESU are late-run winter steelhead, but introduced hatchery stocks of summer and early-run winter steelhead also occur in the upper Willamette River. Estimates of the proportion of hatchery fish in natural spawning escapements range from 5% to 25%. The NMFS is concerned with the potential risks associated with interactions between non-native summer and wild native winter steelhead, whose spawning areas are sympatric in some rivers (especially the Molalla and North and South Santiam rivers). The percentage of hatchery fish in natural spawning escapements is considered relatively low in most rivers in the upper Willamette River basin. Declines in winter steelhead runs, regardless of degree of hatchery influence, suggest that causes other than artificial propagation are primarily responsible for reduced abundances.

NMFS remains concerned about the lack of historical abundance estimates for winter steelhead in the upper Willamette ESU. It is possible that population sizes were never large above Willamette Falls, and that the winter steelhead in this ESU are capable of persisting at relatively low abundances. Although the case is not as extreme as for spring chinook salmon, the proportion and total amount of historical steelhead spawning habitat that has been blocked by dams and water diversions is high in the upper Willamette ESU. It is possible that several years of poor ocean conditions and recent harvest pressure in the lower Columbia River pushed the winter steelhead populations in the upper Willamette drainage to the limit of their resiliency.

Current Range-Wide Status

Steelhead in the UWR ESU are distributed in a few relatively small, natural populations. Over the past several decades, the total abundance of natural, late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000 to 20,000 spawners. However, the last peak occurred in 1988 and it has been followed by a steep and continuing decline. Abundance in each of the last five years has been below 4,300 fish, and the run during 1995 was the lowest in 30 years. Declines have also been observed in almost all natural populations, including those with and without a substantial component of naturally-spawning hatchery fish.

IV.A.6. Columbia River (CR) Chum Salmon

The CR chum salmon ESU includes all progeny of naturally-spawning chum salmon in the Columbia River and its tributaries in Washington and Oregon. Life-history characteristics of CR chum salmon have been reviewed by Johnson et al. (1997). The NMFS listed the CR chum salmon ESU as threatened on March 25, 1999 (64 FR 14508).

Factors for Decline

The Columbia River ESU historically supported commercial landings of hundreds of thousands of chum salmon, with annual landings of nearly half a million fish as recently as 1942. However, beginning in the mid-1950s, commercial catches declined drastically and in later years rarely exceeded 2,000 per year (less than 50 fish per year have been caught since 1994). Because chum salmon are “averse” to surmounting in-river obstacles to migration (the muscles at the base of the tail are weaker than in other salmonids), Bonneville and other lower river dams present significant obstacles to the recovery of upriver populations. Substantial habitat loss in the Columbia River estuary was also probably an important factor and represents a significant continuing risk for this ESU. Currently, the Washington Department of Fish and Wildlife (WDFW) recognizes and monitors only four natural populations in the basin, in Grays River, Hardy and Hamilton creeks, and the Ives Island area. Historically, all of these populations were influenced by hatchery programs and fish transfers, including the Sea Resources Hatchery on the Chinook River that uses Willapa Bay chum stock and had a relatively large return of 3,000 fish in 1993. In 1999, WDFW and NMFS required that these fish be destroyed or released in Willapa Bay. They are not considered part of the CR chum salmon ESU.

Current Range-Wide Status

Historically, CR chum salmon were abundant in the lower reaches of the Columbia River and may have spawned as far upstream as the Walla Walla River (over 500 km inland). Several decades ago, Fulton (1970) reported that chum salmon presently used 22 of 25 historical spawning areas in the lower Columbia River. However, the extent of tributary habitat was limited by natural (falls, heavy rubble and boulders) and manmade structures (dams, water diversions). Habitat quality was limited by siltation where watersheds had been subjected to heavy logging. Kostow (1995) identified 23 potential spawning populations on the Oregon side of the Columbia River but these reports were based on incidental observations (pers. comm., K. Kostow, Fisheries Biologist, ODFW, Portland, Oregon, August 6, 1999).

The overall run for the Columbia River ESU has been relatively stable, albeit at a very low level, since the run collapsed during the mid-1950s. Current abundance is probably less than 1% of historical levels and the ESU has undoubtedly lost some (perhaps much) of its original genetic diversity. Beginning in the mid-1950s, commercial catches declined drastically and now rarely exceed 2,000 per year (less than 50 fish per year have been caught since 1994). Average natural escapement for the period 1990 through 1997 was approximately 1,800 fish per year (ODFW and WDFW 1998). The fact that CR chum salmon have persisted at very low numbers for several decades argues that the ESU is not at immediate risk of extinction. However, the lack of response after elimination of nearly all directed harvest indicates that productivity is depressed and that additional measures must be implemented before the species will be able to recover.

V. EVALUATING PROPOSED ACTIONS

In the 1995 FCRPS Biological Opinion, NMFS described a five-part approach to applying the jeopardy standards in the implementing regulations of the Endangered Species Act to Pacific salmon. The same general approach was applied to determinations for listed steelhead ESUs in the 1998 Supplemental FCRPS Biological Opinion. The analysis involved the following steps:

1. Define the biological requirements and current range-wide status of the listed species;

2. Evaluate the relevance of the environmental baseline to the species' current status;

3. Determine the effects of the proposed or continuing action on listed species;

4. Determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects, and considering measures for survival and recovery specific to other life stages; and

5. Identify reasonable and prudent alternatives to a proposed or continuing action that is likely to jeopardize the continued existence of the listed species.

V.A. Biological Requirements Within the Action Area

V.A.1. Upper Columbia River Spring Chinook Salmon

The action area, relative to UCR spring chinook salmon, is described as the Columbia River migration corridor from the farthest upstream point at which listed spring chinook salmon are affected by the FCRPS operations under consideration (i.e., the mainstem Columbia River below Chief Joseph Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed UCR spring chinook salmon are influenced by Federal water management.

Within the action area, the biological requirements of juvenile UCR spring chinook salmon are very similar to those of other juvenile salmonids in the Columbia River migration corridor. These biological requirements stem from the essential features of the juvenile migration corridor, as described in the critical habitat designation for Snake River spring/summer chinook salmon, fall chinook salmon, and sockeye salmon (58 FR 68543). The biological requirements of juvenile UCR spring chinook salmon include: (1) an adequate substrate; (2) adequate water quality; (3) adequate water quantity; (4) adequate water temperature; (5) adequate water velocity; (6) adequate cover and shelter; (7) adequate food; (8) adequate riparian vegetation; (9) adequate space; and (10) conditions for safe passage.

Further, the biological requirements of adult UCR spring chinook salmon within the action area are very similar to those of other adult salmonids in the Columbia River migration corridor. These requirements are the same as those described for juveniles, with the exclusion of (7) adequate food.

V.A.2. Lower Columbia River Chinook Salmon

The action area, relative to LCR chinook salmon, is described as the Columbia River migration corridor from the farthest upstream point at which listed LCR chinook salmon are affected by the FCRPS operations under consideration (i.e., the mainstem Columbia River below The Dalles Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed LCR chinook salmon are influenced by Federal water management.

Within the action area, the biological requirements of migrating juvenile LCR chinook salmon (both spring- and fall-run components) are very similar to those of other juvenile salmonids in the Columbia River migration corridor (Section V.A.1). Further, the biological requirements of adult LCR chinook salmon within the Columbia River migration corridor are very similar to those of other adult salmonids. However, unlike the species discussed in the 1995 RPA and 1998 supplemental biological opinion, the fall-run component of the LCR chinook salmon ESU has biological requirements for spawning and rearing in the mainstem Columbia River.

V.A.3. Middle Columbia River Steelhead

The action area, relative to MCR steelhead, is described as the Columbia River migration corridor from the farthest upstream point at which listed MCR steelhead are affected by Federal water management (i.e., the mainstem Columbia River below Priest Rapids Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed MCR steelhead are influenced by Federal water management.

Within the action area, the biological requirements of migrating juvenile MCR steelhead are very similar to those of other juvenile salmonids in the Columbia River migration corridor (Section V.A.1). Further, the biological requirements of adult MCR steelhead in the Columbia River migration corridor are very similar to those of other adult salmonids in the action area.

V.A.4. Upper Willamette River Chinook Salmon

In the context of this consultation, the action area relative to UWR chinook salmon is described as the Columbia River migration corridor from the farthest upstream point (i.e., the mainstem Columbia River below Bonneville Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed UWR chinook salmon are influenced by Federal water management. The 13 hydro projects operated by the Corps in the Willamette River basin are also considered part of the FCRPS but NMFS is considering their effects on the UWR chinook salmon ESU in a separate consultation.

Within the action area, the biological requirements of migrating juvenile UWR chinook salmon are very similar to those of other juvenile salmonids in the Columbia River migration corridor (Section V.A.1). Further, the biological requirements of adult UWR chinook salmon in the Columbia River migration corridor are very similar to those of other adult salmonids in the action area.

V.A.5. Upper Willamette River Steelhead

In the context of this consultation, the action area relative to UWR steelhead is described as the Columbia River migration corridor from the farthest upstream point(i.e., the mainstem Columbia River below Bonneville Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed UWR steelhead are influenced by Federal water management. The 13 hydro projects operated by the Corps in the Willamette River basin are also considered part of the FCRPS but NMFS is considering their effects on the UWR steelhead ESU in a separate consultation.

Within the action area, the biological requirements of migrating juvenile UWR steelhead are very similar to those of other juvenile salmonids in the Columbia River migration corridor (Section V.A.1). Further, the biological requirements of adult UWR steelhead in the Columbia River migration corridor are very similar to those of other adult salmonids in the action area.

V.A.6. Columbia River Chum Salmon

The action area, relative to CR chum salmon, is described as the mainstem Columbia River from the farthest upstream spawning habitat (i.e., some unknown point above Bonneville Dam) to the farthest downstream point (the Columbia River plume and the nearshore ocean environment) at which listed CR chum salmon are influenced by Federal water management.

Within the action area, the biological requirements of migrating juvenile CR chum salmon are very similar to those of other juvenile salmonids in the Columbia River migration corridor (Section V.A.1). Further, the biological requirements of adult CR chum salmon in the Columbia River migration corridor are very similar to those of other adult salmonids in the action area. However, unlike the species discussed in the 1995 RPA and 1998 supplemental biological opinion, CR chum salmon ESU have biological requirements for spawning and rearing in the mainstem Columbia River.

V.B. Biological Requirements That Apply to All Actions and Action Areas

At the species level, the biological requirements of chinook and chum salmon and steelhead include population numbers, trends, geographic distribution, life-history and phenotypic variability, and genetic heterogeneity that are sufficient to ensure survival with an adequate potential for recovery. Knowledge of the species-level biological requirements (i.e., over the full life cycle) allows NMFS to assess whether they are adequately met under the environmental baseline and whether that status is likely to be changed by the proposed action.

The NMFS and USFWS issued a "Section 7 Endangered Species Consultation Handbook -- Procedures for Conducting Section 7 Consultations and Conferences" during March 1998 (hereafter "the Consultation Handbook"). The Consultation Handbook defines the regulatory terms "survival" and "recovery" for use in jeopardy/critical habitat analyses as follows:

> Survival: For determination of jeopardy/adverse modification: the species' persistence, as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.
>
> Recovery: improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act. [50 CFR §402.02]

V.C. Relevance of the Environmental Baseline to the Species' Current Status

The biological requirements of UCR spring chinook salmon, LCR chinook salmon, MCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon are currently not being met under the environmental baseline, which is apparent from the species' declining status in recent years (Section IV). Maintenance over the long term or further degradation of these conditions would not reverse the declining trends and thus would continue to increase the amount of risk from adverse effects that listed salmonid populations face under the environmental baseline. Continuation of FCRPS actions that were initiated at upper Columbia River storage projects and in the lower Columbia River projects in response to previous consultations for the listed UCR and SR salmon and steelhead ESUs are expected to work toward slowing this trend toward extinction for the species considered in this consultation.

V.D. Determining the Effects of the Proposed or Continuing Actions on Listed Species

Mortality and sublethal effects (e.g., changes in migration timing or speed) associated with river impoundment, dam passage, and other aspects of Columbia and Snake river project operations are described in Section VI.

V.E. Likelihood That the Species Can Be Expected to Survive With an Adequate Potential for Recovery Under the Effects of the Proposed or Continuing Action, the Environmental Baseline and Any Cumulative Effects, and Considering Measures for Survival and Recovery Specific to Other Life Stages

V.E.1. Determine the Significance of the Aggregate Effect Upon the Particular Biological Requirements of the Listed Species in the Action Area

V.E.1.a. Upper Columbia River Spring Chinook Salmon

The biological requirements of UCR spring chinook within the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1). The proposed action has already been determined not to jeopardize these three species. The biological requirements of UCR spring chinook salmon during the rest of the interim period will be considered to be satisfied unless a comparison of the timing of the species' biological requirements in the action area indicates that different or additional protective measures are needed.

In making this determination, NMFS must consider each element of the 1995 RPA and 1998 supplemental biological opinion and terms and conditions of the incidental take statements to ensure that UCR spring chinook salmon receive, at a minimum, the same protection afforded to Snake River spring/summer chinook salmon and UCR steelhead. These protections rely upon:

1. Interim actions, intended to provide for "implementation of all reasonable measures for the operation and configuration of the FCRPS that will reduce the mortalities of listed fish" (1995 FCRPS Biological Opinion, p. 91) and studies to support the choice of a best long-term action and

2. Long-term actions, which include "major structural improvements to the FCRPS that result in significant survival improvements" (1995 FCRPS Biological Opinion, p. 128).

The 1995 FCRPS Biological Opinion recognized that the interim action, if carried out indefinitely into the future, would jeopardize Snake River salmon and that, therefore, a long-term action which further reduces FCRPS-caused mortality was required for survival and recovery of listed species. The 1995 RPA determined that there were several alternative long-term actions, any one of which might avoid jeopardy, depending upon the accuracy of its supporting assumptions. Until the best long-term action is chosen and implemented, the interim action "aggressively pursues improvements in survivals of both in-river migrants and transported fish" to keep the status of the listed species from deteriorating further before the long-term action is implemented.

The interim actions adopted in 1995 and 1998 must be reviewed with respect to reductions in FCRPS-related mortalities of UCR spring chinook salmon compared to Snake River spring/summer chinook salmon and UCR steelhead. Particular questions include:

- Does the timing of the biological requirements of UCR spring chinook salmon in the action area differ from that of SR spring/summer chinook salmon and UCR steelhead?

- For each interim measure in the 1995 RPA and the 1998 supplemental biological opinion, does the timing of the measure provide the same opportunity for reductions in FCRPS-related mortalities for UCR spring chinook salmon as for SR spring/summer chinook salmon and UCR steelhead.

- Have all reasonable interim measures that would be likely to reduce FCRPS-related mortalities of UCR spring chinook salmon been included?

The suite of interim studies must be reviewed to determine if the conclusions of those studies will provide adequate information for determining whether a long-term FCRPS management action will ensure the survival of UCR spring chinook salmon with adequate potential for recovery. This suite includes the Lower Columbia River Feasibility Study, proposed by the Action Agencies as an evaluation (scoping, design, engineering, and feasibility study) of potential alternative configurations of lower Columbia River hydro projects to enhance the survival of listed Columbia River basin salmonids. In addition, the adequacy of each long-term alternative must also be evaluated with respect to UCR spring chinook salmon.

V.E.1.b. Lower Columbia River Chinook Salmon

To the extent that the biological requirements of LCR chinook salmon in the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1), hydrosystem-related effects on each species are compared in Section VI. However, the fall-run component of the LCR chinook salmon ESU also spawns in an area that is affected by FCRPS water management so it is necessary to add a discussion of the effects of proposed operation on biological requirements specific to spawning, incubation, emergence, and rearing. Interim and long-term elements of the 1995 RPA and 1998 supplemental biological opinion are reviewed in the context of the timing of biological requirements of LCR chinook salmon in the action area, employing the considerations described for UCR spring chinook salmon in Section V.E.1.a and additional considerations related to use of the mainstem for spawning, incubation, emergence, and rearing.

V.E.1.c. Middle Columbia River Steelhead

Because the biological requirements of MCR steelhead in the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1), hydrosystem-related effects on each species are compared in Section VI. Interim and long-term elements of the 1995 RPA and 1998 supplemental biological opinion are reviewed in the context of the timing of biological requirements of MCR steelhead in the action area, employing the considerations described for UCR spring chinook salmon in Section V.E.1.a.

V.E.1.d. Upper Willamette River Chinook Salmon

Because the biological requirements of UWR chinook salmon in the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1), hydrosystem-related effects on each species are compared in Section VI. Interim and long-term elements of the 1995 RPA and 1998 supplemental biological opinion are reviewed in the context of the timing of biological requirements of UWR chinook salmon in the action area, employing the considerations described for UCR spring chinook salmon in Section V.E.1.a.

V.E.1.e. Upper Willamette River Steelhead

Because the biological requirements of UWR steelhead in the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1), hydrosystem-related effects on each species are compared in Section VI. Interim and long-term elements of the 1995 RPA and 1998 supplemental biological opinion are reviewed in the context of the timing of biological requirements of UWR steelhead in the action area, employing the considerations described for UCR spring chinook salmon in Section V.E.1.a.

V.E.1.f. Columbia River Chum Salmon

To the extent that the biological requirements of CR chum salmon in the action area are estimated to be similar to those of Snake River chinook salmon, UCR steelhead, and LCR steelhead (Section V.A.1 hydrosystem-related effects on each species are compared in Section VI. However, because CR chum salmon also spawn in the mainstem, it is necessary to add a discussion of the effects of proposed operation on biological requirements specific to incubation, emergence, and rearing. Interim and long-term elements of the 1995 RPA and 1998 supplemental biological opinion are reviewed in the context of the timing of biological requirements of CR chum salmon in the action area, employing the considerations described for UCR spring chinook salmon in Section V.E.1.a and for LCR chinook salmon in Section V.E.1.b.

V.E.2. Effects of the Proposed Or Continuing Action in the Context of the Full Life Cycle to Determine If Species-Level Biological Requirements Are Likely to Be Met

V.E.2.a. Upper Columbia River Spring Chinook Salmon

The 1995 FCRPS Biological Opinion applied quantitative analytical techniques developed and implemented by a multi-agency technical group to assess whether operation of the FCRPS would satisfy species-level biological requirements of Snake River spring/summer chinook salmon. Development of the analytical methods (risk analysis framework) and tools (e.g., run reconstructions and simulation models) took several years. Analogous tools for comprehensive evaluation of species-level biological requirements are currently not available for UCR spring chinook salmon. However, a comprehensive modeling analysis of UCR spring chinook salmon is currently planned by NMFS in cooperation with the Action Agencies, the Implementation Team, the regional fish and wildlife managers, the MCCC, and the Douglas, Chelan, and Grant PUDs. The Quantitative Analysis Report (QAR) is scheduled to be completed in 2000. The NMFS will use this information in its analysis of the effects of the proposed long-term FCRPS action during the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

Until the QAR analysis is available, NMFS cannot quantitatively evaluate the effects of the proposed long-term FCRPS action on the species-level biological requirements of UCR spring chinook salmon. The assessment in Section VI is based on qualitative considerations including the extent to which FCRPS-related mortality has contributed to the declining status of this ESU. Factors for the decline of this ESU include hydrosystem effects, but the relative importance of FCRPS-related mortality compared to other sources of mortality (e.g., passage through up to five hydro projects in the mid-Columbia reach owned and operated by Public Utility Districts and hatchery practices) cannot be quantitatively addressed at this time.

V.E.2.b Lower Columbia River Chinook Salmon and Middle Columbia River Steelhead

Tools for comprehensive evaluations of the species-level biological requirements of LCR chinook salmon and MCR steelhead are currently not available. However, as described in Section III.B, the Action Agencies have proposed to fund and where appropriate, participate in, a comprehensive analysis of the effects of the FCRPS on the biological requirements of LCR chinook salmon. Until this analysis is available, NMFS cannot quantitatively evaluate the effects of the proposed action on the species-level biological requirements of LCR chinook salmon or MCR steelhead. The assessment in Section VI is based on qualitative considerations, including the extent to which FCRPS-related mortality has contributed to the declining status of these ESUs. Factors for the decline of these ESUs include hydrosystem effects, but the importance of FCRPS-related mortality compared to other sources of mortality (harvest, hatcheries, and habitat actions) cannot be quantitatively addressed at this time.

V.E.2.c. Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead

Tools for comprehensive evaluations of the species-level biological requirements of UWR chinook salmon and UWR steelhead are currently not available. As described above, the assessment in Section VI is based on qualitative considerations including the extent to which FCRPS-related mortality has contributed to the declining status of these ESUs. Factors for the decline include the effects of mainstem Columbia River hydro projects, but the importance of FCRPS-related mortality compared to other sources of mortality (e.g., the effects of 13 Corps-operated flood control projects in the upper Willamette River basin) cannot be quantitatively assessed at this time.

V.E.2.d. Columbia River Chum Salmon

Tools for comprehensive evaluations of the species-level biological requirements of CR chum salmon are currently not available. As described above, the assessment in Section VI is based on qualitative considerations including the extent to which FCRPS-related mortality has contributed to the declining status of this ESU. Factors for the decline include hydrosystem effects, but the importance of FCRPS-related mortality compared to other sources of mortality cannot be quantitatively assessed at this time.

V.F. Reasonable and Prudent Alternatives to a Proposed Or Continuing Action That is Likely to Jeopardize the Continued Existence of the Listed Species

This step is relevant only when the conclusion of the previously-described analysis is that the proposed action will jeopardize listed species. The reasonable and prudent alternative will have to reduce mortality associated with the proposed action to a level that does not jeopardize the species. An analysis to determine sufficiency of the reasonable and prudent alternative will be based on the same considerations described above.

VI. ANALYSIS OF EFFECTS

VI.A. Effects of Proposed FCRPS Operation by the Action Agencies

VI.A.1. Effects of Water Regulation and Impoundment of Mainstem Free-Flowing River Sections

VI.A.1.a. Effects of Water Regulation and Impoundment With Respect to Biological Requirements Within the Action Area

Water regulation by the Action Agencies results in modification of the natural hydrograph and affects the newly listed species in the area between upriver storage reservoirs and the part of the nearshore ocean that is influenced by the Columbia River plume. Water regulation reduces flows (volume per unit time) that would naturally occur during spring and this in turn reduces water velocity. Water velocity is further reduced by impoundment of mainstem river sections, which increases volume and cross sectional area, creating reservoirs in sections of a formerly free-flowing river. Water regulation and impoundment also change water quality factors such as temperature (increased due to mass heat storage in reservoirs) and turbidity (decreased), as well as the production of salmonid prey (which changes from aquatic insects in a free-flowing river to lacustrine planktonic organisms in a reservoir). Channel complexity is also reduced in reservoirs, which affects fluid dynamics (e.g., ISG 1996) and substrate types. In addition, load-following operations at FCRPS projects (hourly and daily load following and reduced weekend flows) change access to suitable spawning habitat and can trap and strand both adults and juveniles.

Upper Columbia River spring chinook salmon must pass through four Federal impoundments (plus up to five non-Federal impoundments in the mid-Columbia reach). MCR steelhead must pass through up to four Federal impoundments, and some LCR chinook salmon pass through one. The extent to which juveniles from the CR chum salmon ESU may be affected by migrating through FCRPS reservoirs is unknown because there is uncertainty about the amount of spawning above Bonneville Dam. Juvenile UWR chinook salmon and UWR steelhead do not pass through any FCRPS reservoirs on the mainstem Columbia River.

Slower water velocity is associated with a reduction in the migration speed of juvenile chinook salmon and steelhead (e.g., Berggren and Filardo 1993, Buettner and Brimmer 1995, Giorgi et al. 1997) and an increase in adult steelhead migration speed during active migration seasons (e.g., reviews in Bjornn and Peery 1992 and Chapman et al. 1994). A slower juvenile migration rate may result in arrival at the estuary at a time or under conditions different from those under which the species evolved, which could influence survival. Impoundment has increased the availability of microhabitats in the range preferred by some predators (NMFS 1999b), higher water temperatures have increased predation rates (e.g., Vigg and Burley 1991), and slower fish migration speeds and the concentration of fish at dams have presumably increased the exposure of juvenile chinook salmon and steelhead to predation. The lack of natural complexity within the migration corridor and the shift in juvenile prey associated with lacustrine habitat may also affect juvenile survival (ISG 1996). These and other potential causal relationships (see Figure 6.1 in ISG 1996) suggest that the survival of juvenile salmonids is reduced by the impoundments and low flows caused by Federal water regulation.

VI.A.1.b. Reduction of Adverse Effects of Water Regulation and Impoundment Through Proposed Measures

In the following sections (and as described in Section V.E.1), the NMFS reviews the interim actions adopted in the 1995 and 1998 biological opinions with respect to reductions in FCRPS-related mortalities of the newly-listed species compared to the species considered in previous consultations. Particular questions include:

- Does the timing of the biological requirements of each of the newly-listed species in the action area differ from those of species previously considered?

- For each interim measure in the 1995 RPA and the 1998 supplemental biological opinion, does the timing of the measure provide the same opportunity for reductions in FCRPS-related mortalities for the newly-listed species as for species previously considered?

- Have all reasonable interim measures that would be likely to reduce FCRPS-related mortalities of the newly-listed species been included?

The suite of interim studies are reviewed to determine if the conclusions of those studies will provide adequate information for determining whether a long-term FCRPS management action will ensure the survival of each of the newly-listed species with adequate potential for recovery.

VI.A.1.b.1) Reduction of Adverse Effects of Water Regulation and Impoundment Through Flow Management

<u>Interim Measures in the 1995 and 1998 Supplemental FCRPS Biological Opinion</u> Flow augmentation is a special case of water regulation, in which the primary purpose of releases from storage reservoirs is to aid salmonid migration rather than to generate power. During the interim period, reservoir storage and release operations are modified to improve juvenile salmon and steelhead migration conditions, as determined by the in-season management process, without drafting storage reservoirs below levels that would reduce the water available in subsequent years (1995 RPA Measure 1).

The Action Agencies (BPA and BoR) have pursued additional sources of water in keeping with the 1995 RPA and the Action Agencies' Records of Decision. The BoR has reacquired and applied about 60,000 acre-feet of storage space in its projects in the Snake River basin for flow augmentation and signed a 5-year lease for 38,000 acre-feet of storage in the upper Snake River. The BoR negotiated with the State of Idaho to facilitate acquiring and releasing up to 427,000 acre-feet of stored water for salmon flow augmentation until January 1, 2000 (NMFS 1999c). Efforts to extend this agreement are ongoing. The BPA has worked with Canadian interests to provide up to 1 MAF of stored water from Canadian projects during the salmon outmigration season. The BPA continues to engage with BC Hydro to define Canadian projects in a manner beneficial to fish resources in both countries. For UCR spring chinook salmon, LCR chinook salmon, and MCR steelhead, flow management during the interim period (i.e., the spring flow objectives at Lower Granite, Priest Rapids, and McNary dams, as described in 1995 RPA Measure 1 and in the first element of the proposed action in the 1998 Supplemental FCRPS Biological Opinion) was designed to partially mitigate the effects of Federal water regulation and impoundments.

<u>Long-Term Measures in the 1995 and 1998 Supplemental FCRPS Biological Opinions</u> The long-term flow augmentation actions in the 1995 RPA included identifying and providing additional volumes of water for flow augmentation from the upper Snake River and Canada (1995 RPA Measures 1[b] and 1[d], respectively). Studies to determine the most effective use of available water are also required (e.g., flow "pulsing" evaluation [1995 RPA Measure 13(g)], and various flow/survival studies [1995 RPA Measures 13(c) and 13(f)]). The Action Agencies adopted a flow objective for the mid-Columbia reach (135 kcfs between April 10 and June 30) in the 1998 supplemental biological opinion. Various other measures included a shift in flood control timing to increase the likelihood that the mid-Columbia flow objective could be met.

The migrations of juvenile UCR spring chinook salmon, LCR chinook salmon, and MCR steelhead overlap in time with those addressed by the Lower Granite and McNary flow objectives in the 1995 RPA and 1998 supplemental biological opinion (i.e., SR spring/summer chinook salmon and UCR steelhead). Therefore, juveniles of the newly-listed species are expected to be provided with similar reductions in mortality associated with water regulation.

Adults of two of the newly-listed species (LCR chinook salmon and CR chum salmon) are affected by water regulation in a manner not considered for species addressed in the 1995 RPA and 1998 supplemental biological opinion, access to mainstem spawning habitat in the Ives Island area. Effects of the proposed action on this aspect of the species' biological requirements are discussed in Sections VI.A.1.c.3) and V.A.1.c.4).

VI.A.1.b.2) Reduction of Adverse Effects of Water Regulation and Impoundment by Lowering Reservoir Elevations

<u>Interim Measures in the 1995 RPA and 1998 Supplemental FCRPS Biological Opinion</u> Reducing the cross-sectional area of a reservoir is equivalent (from the standpoint of average water velocity) to increasing flow. Therefore, the Action Agencies were directed to investigate reducing the elevation of John Day pool to within three feet of MOP during the juvenile migration period (1995 RPA Measure 5). However, in the 1998 supplemental biological opinion

this measure was superceded by a proposal to investigate deeper drawdowns at John Day Dam while also investigating surface bypass technology, guidance efficiency improvements, and other system improvements at all of the lower Columbia River projects (see Long-Term Measures, below).

<u>Long-Term Measures in the 1995 and 1998 Supplemental FCRPS Biological Opinions</u> Spillway crest drawdowns could potentially reduce adverse effects of water management and impoundment, whereas natural river drawdowns would additionally reduce adverse effects of migration barriers (see Section VI.A.3). The Lower Columbia River Feasibility Study proposed in the 1998 supplemental biological opinion would consider John Day and McNary drawdowns and full-flow bypass at some projects, as well as other measures already anticipated in the 1995 RPA. The Corps sought appropriations to initiate the feasibility study. Although Congress approved funds for the Phase I study of a John Day drawdown in the Conference Report on the Energy and Water Development Appropriations Act for 2000, it prohibited the Corps from using any appropriation found in the act to initiate a study of the drawdown at McNary Dam unless authorized by law. The Phase I study is nearing completion and, once completed, will be the basis for an FY2001 funding request.

VI.A.1.b.3) Reduction of Adverse Effects of Water Regulation and Impoundment by Predator Removal

<u>Interim and Long-Term Measures in the 1995 and 1998 Supplemental FCRPS Biological Opinions</u> Measure 14 of the 1995 RPA required that the Action Agencies continue to evaluate predator removal as a means of reducing reservoir predation, partially mitigating the effect of impoundments in creating low-velocity predator habitat and the effect of dams in concentrating juvenile smolts, making them more susceptible to predation. Term and Condition 1.h of the Incidental Take Statement in the 1998 Supplemental FCRPS Biological Opinion went further in requiring that the Action Agencies install and maintain effective means of reducing avian predation at FCRPS dams. Additionally, the 1995 RPA directed the Action Agencies to study the effects of Caspian tern predation and methods to discourage tern predation at Rice Island in the Columbia River estuary (Term and Condition 9 of the Incidental Take Statement [IT 9]).

VI.A.1.b.4) Reduction of Adverse Effects of Water Regulation and Impoundment by Temperature Regulation

In-season management by the TMT, as described in 1995 RPA measure 1(g), and improved water conditions during the past five years have resulted in reduced summer temperatures in the lower Snake River. However, the water temperature preferred by listed salmonids in the lower Snake and Columbia Rivers has not been achieved.

<u>Interim and Long-Term Measures in the 1995 FCRPS Biological Opinion</u> IT 17 in the 1995 RPA called for monitoring river temperatures and implementing, when possible, temperature control measures in the lower Snake River – such as timing the release of cool water from Dworshak Dam and the Hells Canyon complex to moderate temperatures. Measures were also required to alleviate warm

temperatures in the McNary Dam juvenile fish facility (IT 5) and in adult fish ladders at various projects (IT 18).

The structural and operational measures in the 1995 RPA and the 1998 supplemental biological opinion for avoiding adverse effects of mainstem temperatures on adult salmonids are also likely to benefit the newly listed species during the rest of the interim period. In addition, because summer temperatures in the upper Columbia River are often substantially lower than those in the Snake River (Corps, Annual Fish Passage Reports), UCR spring chinook salmon experience high temperatures for a shorter period of time than Snake River spring chinook salmon or Snake River steelhead. Lower Columbia River chinook salmon, MCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon, which migrate shorter distances in the Columbia River, should be even less affected by high mainstem temperatures.

VI.A.1.c. Specific Characteristics of Upper Columbia River Spring Chinook Salmon, Lower Columbia River Chinook Salmon, Middle Columbia River Steelhead, Upper Willamette River Chinook Salmon, Upper Willamette River Steelhead, and Columbia River Chum Salmon that Relate to the Seasonality and Geographic Extent of the Effects of Water Regulation and Impoundment

VI.A.1.c.1) Upper Columbia River Spring Chinook Salmon or Middle Columbia River Steelhead

The NMFS has not defined specific flow objectives or planning dates for flow augmentation to benefit UCR spring chinook salmon or MCR steelhead. However, the peak timing of the juvenile migrations of each of these two species overlaps with those of SR spring/summer chinook salmon and UCR steelhead, considered in the 1995 RPA and the 1998 supplemental biological opinion (Table VI-1). Therefore, the timing of the flow objectives at McNary Dam (for SR spring/summer chinook salmon) and at Priest Rapids Dam (for UCR steelhead) are not likely to jeopardize the survival of UCR spring chinook salmon or MCR steelhead during the rest of the interim period.

VI.A.1.c.2) Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead

The NMFS assumes that the principal effects of FCRPS operations on the biological requirements of UWR chinook salmon and UWR steelhead are associated with thirteen Federal hydroelectric projects on the Willamette River and its tributaries. The Corps is addressing these effects in a separate consultation with NMFS and they will not be discussed further here. However, UWR chinook salmon and steelhead are affected by the operation of the Columbia and Snake river FCRPS projects in the juvenile and adult migration corridor when they are in the mainstem Columbia River and the estuary, downstream from the confluence of the Willamette River at Portland, Oregon.

The outmigration of juvenile UWR chinook salmon begins (January) and peaks (February and March) earlier than that of other spring or summer chinook in the Columbia basin (Table VI-1, Figure VI-1[6]). A recent detailed study of water use (BoR 1999) indicated that, prior to water management for irrigation (c. 1880s), flows below Bonneville Dam averaged less than 125 kcfs in both January and February and frequently dropped below 100 kcfs (Figure VI-2). The Action Agencies' proposal (Section III.A.2) to maintain an instantaneous minimum flow of 120 kcfs throughout this period (i.e., no lower than 125 kcfs minus 5 kcfs at any instant[7]) would provide flows in the portion of the Columbia River occupied by UWR chinook salmon and steelhead higher than those historically experienced by these fish. Therefore, the NMFS assumes that the average monthly flows now experienced by juvenile UWR chinook salmon during February and March[8] are consistent with the biological requirements of this ESU during the rest of the interim period.

The peak timing of the juvenile migration of UWR steelhead overlaps with those of SR spring/summer chinook salmon and UCR steelhead, considered in the 1995 RPA and the 1998 supplemental biological opinion (Table VI-1). Therefore, the timing of the flow objectives at McNary Dam (for SR spring/summer chinook salmon) and at Priest Rapids Dam (for UCR steelhead) are not likely to jeopardize the survival of UWR steelhead during the rest of the interim period.

VI.A.1.c.3) Lower Columbia River Chinook Salmon

Juveniles

The juvenile outmigration of LCR chinook salmon in the mainstem Columbia River extends from March through August, peaking during April. Thus, it overlaps in time with the juvenile outmigrations of chinook salmon species addressed by the McNary flow objective in the 1995 RPA (i.e., SR spring/summer chinook salmon and SR fall chinook salmon, Section VI.A.1.b.1). Lower Columbia River chinook salmon are expected to be provided with reductions in mortality associated with water regulation similar to those afforded the Snake River chinook salmon ESUs migrating through the lower reaches of the Columbia River.

Adults

Field biologists from ODFW, WDFW, and USFWS observed fall chinook salmon spawning in the Ives Island area beginning in 1993. The population appears to have spawned each year since then. The NMFS considers these fish, which are called "lower river brights" (LRB), part of the Upper

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[6] Some juvenile UWR chinook salmon are in the mainstem throughout the year although the Oct/Nov peak in Figure VI-1 is dominated by hatchery releases during 1992 through 1995.

[7] Minimum flow during incubation and emergence of chum salmon fry in the Ives Island area.

[8] Outmigrating UWR chinook salmon reaching the mainstem Columbia River after April 20th experience flows augmented to reach the McNary flow objective per the 1995 RPA.

Columbia River summer- and fall-run ESU (64 FR 14314). As such, they are not listed under the ESA and are not a subject of this biological opinion.

There is also evidence that listed fish (i.e., from the fall-run component of the LCR chinook salmon ESU) contributed to spawning in the Ives Island area during the first three weeks of October 1999. These tule-type fall chinook salmon were distinguished from upriver or lower river brights by their body color (brownish tinge) and shape as well as early run-timing (pers. comm. [E-mail], J. Hymer, WDFW, Vancouver, Washington, October 20, 1999). A coded-wire tag recovered on October 12, 1999, indicated that some proportion of the early spawners are likely to be strays from Spring Creek National Fish Hatchery (NFH)[9]. The WDFW has initiated genetic studies to determine the origin of these spawners, but because NMFS treats all progeny of naturally-spawning Lower Columbia River ("tule") fall chinook salmon as listed for purposes of the ESA (64 FR 14324), their progeny are a subject of this biological opinion.

The hydraulic connection between Hamilton Slough (between the Washington shoreline and Ives and Pierce islands) and the mainstem Columbia River and the areal extent of submerged spawning gravels are strongly affected by FCRPS water management. According to USFWS, ODFW, and WDFW field biologists (unpublished data), a Bonneville discharge of 125 kcfs is needed to create and sustain the connections, with additional flow needed to counteract a drop in river elevation during the lower low of a spring tidal cycle. Creating and maintaining these hydraulic connections provides access for adults to spawning areas, prevents dewatering of redds during incubation, and provides an emigration route for juveniles after emergence. Minimizing daily and weekend load-following operations reduces the likelihood that adults and juveniles will become trapped and stranded.

The run timing of the fall component of the LCR chinook salmon ESU extends from September through early November, peaking in late September and early October (Myers et al. 1998). At NMFS' request, BPA performed a continuous hydroregulation study (HydSim) for the <u>50-year</u> period beginning 1929[10]. The purpose of the continuous study was to evaluate the effect of a flow augmentation operation in the Ives Island area, beginning October 15th, during a series of water years (1929 through 1978). The continuous study showed that providing a Bonneville discharge of 125 kcfs from October 15th through April 10th would reduce the probability of refilling Grand Coulee to upper

[9] The tag was recovered from a 3-year old fish released in 1996. The tag rate for 1996 brood fall chinook that returned to Spring Creek Hatchery in 1998 was 3.4%. The WDFW sampled approximately 30 carcasses from below Bonneville during October 5-20, 1999, and recovered one tag, a tag rate of 3.3%.

[10] A 50-year continuous hydroregulation study is run with 1929 through 1978 historic water year sequences and reservoir storage for each water year starting where the previous water year ended. Continuous studies are most frequently used to draw comparisons of effects on reservoir elevations, flow for fish, energy surplus/deficits, and power revenues, for example, in a generic time period. Two studies which regulate the system to different operating criteria are often compared. The important distinction from a refill study is that the continuous study is not used for analyzing any specific near-term future time period but is used as a tool to analyze a generic long-term period.

rule curve by April 15^{th} to 80% from the biological opinion requirement of 85% (Table VI-2). The study indicated that two alternative flow augmentation programs that are more aggressive in the use of reservoir storage to support October flows would reduce the probability of refill to 78% and 64%, respectively.

A second HydSim study evaluated the proposed operation over the 60-year water record, assuming that each water year were to begin with the volumes that were actually in storage on October 15, 1999 (a La Niña-type water year). In this study, the probability of refill was reduced from the biological opinion requirement of 85% to 83% for Option 1 (125 kcfs October 15 through April 15), to 80% or less (depending on whether BPA would draft Grand Coulee for power during a January cold snap) for Option 2, and to 70% or less for the most aggressive flow augmentation operation, Option 3 (Table VI-3). In light of these hydroregulation studies, the use of reservoir storage to provide spawning flows in the Ives Island area as early as September through October for LCR chinook salmon would increase the risk to the probability of refilling Grand Coulee to upper rule curve by April 10. This would, in turn, increase risk to the downstream survival of juveniles of several listed species, as described in Section VI.A.1.b.

In determining the effects of the proposed action on listed species, NMFS must weigh the expected benefit of managing water to provide a high likelihood of improving conditions in the juvenile migration corridor for various species against the possible detrimental effects of reducing LCR chinook salmon access to Ives Island spawning habitat. In weighing this tradeoff, it is important to consider that hatchery versus wild origin of the Ives Island spawners and, if wild, the significance of the spawning area to the diversity and populations structure of the ESU (i.e., the Ives Island area is the only documented mainstem chinook salmon spawning site remaining in the lower Columbia River). During the interim period, it is reasonable to collect additional information to resolve uncertainties regarding the importance of LCR chinook salmon spawning naturally in the Ives Island area (Section III.B.2). The risk during the interim period may be low because: (1) the rate of recovery of coded-wire tags from Spring Creek NFH at Ives Island is nearly identical to the marking rate and (2) historical flows prior to development of the hydrosystem for irrigation [c. 1880] were less than 125 kcfs during late September and early October, the peak of tule fall chinook salmon spawning in the lower Columbia River. The alternative would clearly pose a significant risk of not meeting the biological requirements of other listed ESUs, as described in the 1995 RPA and 1998 supplemental biological opinion.

VI.A.1.c.4) Columbia River Chum Salmon

Juveniles

Juvenile CR chum salmon migrate immediately upon emergence (approximately 40 mm in length). In general, their biological requirements during outmigration are assumed to be similar to those of other subyearling migrants in the mainstem Columbia River (below Bonneville Dam), the estuary, the plume, and the nearshore ocean environment. Subyearling migrant CR chum salmon are spring rather than the summer migrants, considered in the 1995 RPA (i.e., SR fall chinook salmon). However, mainstem flows during the peak of the chum salmon outmigration period (April, Table VI-1) are augmented by reservoir releases to meet the Lower Granite, Priest Rapids, and McNary flow targets per the 1995 RPA and 1998 supplemental biological opinion.

Juvenile CR chum salmon have an additional biological requirement related to Columbia River flow – river elevations during emergence must connect spawning areas to mainstem migration corridors. The connection between at least one chum salmon spawning area (Hamilton Creek) and the mainstem Columbia River is partially influenced by Federal water management. The Action Agencies have proposed to manage reservoir storage with natural flows during emergence to maintain connectivity (Section III.A.2) and to minimize the likelihood of entrapment and stranding, provided that the operation does not impair the ability of parties to comply with the 1995 RPA and 1998 supplemental proposed action or the terms of the Vernita Bar agreement.

Adults

As described above for LCR chinook salmon, in determining the effects of the proposed action on listed species, NMFS must weigh the expected benefit of managing water to provide a high likelihood of improving conditions in the juvenile migration corridor for various species against the possible detrimental effects of reducing CR chum salmon access to Ives Island spawning habitat. In this case, it is important to consider whether the Ives Island spawning aggregation represents an independent population and the significance of the spawning area to the ESU. During the interim period, it is reasonable to collect additional information to better determine if fall flow augmentation is a biological requirement of chum salmon. The Action Agencies therefore propose to collect additional information to resolve the importance of CR chum salmon spawning naturally in the Ives Island area to the diversity and population structure of the ESU (Section III.B.5). The risk to the ESU during the interim period may be low because: (1) the abundance of CR chum salmon has been stable for several decades (albeit at a very low level) and (2) prior to 1997, flow fluctuations during November, the peak month for chum salmon spawning in the lower Columbia River, were greater than those specified in the proposed operation (Figure VI-3)[11]. The alternative would clearly pose a significant risk of not meeting the biological requirements of other listed ESUs, as described in the 1995 RPA and 1998 supplemental biological opinion.

VI.A.2. Effects of Barriers to Migration

[11] Bonneville Dam routinely has been operated as a load-following project with substantial variations in discharge rates on hourly, daily, and weekday/weekend scales. These variations have resulted in daily ranges in discharge much larger than the ± 5 kcfs recommended by NMFS. For example, according to data provided by BPA (spreadsheet titled \bonflow.xls), the median daily range (i.e., median of daily maxima minus daily minima) during November was 45 kcfs in 1994, 60 kcfs in 1995, 49 kcfs in 1996, and 51 kcfs in 1997, the four years preceding operations to support Ives Island spawning. The NMFS believes that its recommendation of a target daily average discharge ± 5 kcfs for the rest of the interim period represents a significant improvement over these unregulated flows.

VI.A.2.a Effects of Barriers to Migration With Respect to Biological Requirements Within the Action Area

The presence of dams results in some migration delay, thereby influencing the migration speed and timing of juvenile salmonids. Dams also impede the safe passage of juveniles and, to a lesser extent, adults. Some juvenile mortality is associated with all routes of passage at dams, with highest mortality occurring through turbines (e.g., reviewed in Whitney et al. 1997). Some passage routes have additional effects, such as the increase in total dissolved gas (water quality) caused by high spill levels.

Dam passage affects the survival of the species considered in this 2000 supplemental biological opinion to varying degrees. Upper Columbia River spring chinook salmon migrate past four Federal and up to five non-Federal projects, MCR steelhead migrate past up to four Federal projects, and some of the spawning populations in the LCR chinook salmon ESU migrate past Bonneville Dam. Fulton (1970) provides historical reports of CR chum salmon spawning populations upstream from Bonneville Dam, although the two populations currently recognized (Grays River and Hardy/Hamilton creeks) are further downstream. Because individuals from two of the ESUs (UWR chinook salmon and UWR steelhead) enter the Columbia River below Bonneville Dam, the effects of mainstem Columbia River dams as barriers to migration are not considered for these two species.

VI.A.2.b. Reduction of Adverse Effects of Barriers to Migration Through Proposed Measures

VI.A.2.b.1) Reduction of Adverse Effects of Barriers to Migration Through Spill

Interim Measures in the 1995 FCRPS Biological Opinion Because mortality associated with juvenile passage via the spillway is very low (e.g., 0% to 2%, based on a review of 13 studies by Whitney et al. 1997), minimum spill levels were established at all projects to reduce the proportion of smolts passing through turbines (1995 RPA Measure 2). To allow higher spill levels without causing detrimental effects of high total dissolved gas (TDG) levels, NMFS required the Action Agencies to perform gas abatement studies and to implement specific measures such as spill deflectors at Ice Harbor and John Day dams (1995 RPA Measure 18). Physical and biological monitoring of TDG effects was also required (1995 RPA Measure 16).

Interim Measures in the 1998 Supplemental FCRPS Biological Opinion The 1998 supplemental opinion modified the requirement to maximize spill at each project up to limits imposed by dissolved gas production. This element of the interim operation results in higher fish passage efficiency and fewer spring migrants transported. The initial planning date for spill at lower Snake River dams was changed from April 10 to April 3 to reflect the earlier migration timing of Snake River steelhead.

Long-Term Measures in the 1995 FCRPS Biological Opinion The NMFS required the Action Agencies to perform studies to examine methods of more effectively attracting surface-oriented juveniles to the spillway (1995 RPA Measure 11), with the intention of implementing new designs in the future if tests are successful. 1995 RPA Measure 18 specified interim period gas abatement measures such as spill deflectors and also required studies to identify long-term gas abatement measures such as tailrace modifications.

Long-Term Measures in the 1998 Supplemental FCRPS Biological Opinion The 1998 supplemental opinion established the following Terms and Conditions of the Incidental Take Statement related to spill: (1.j) investigate spillway survival at all FCRPS dams, (1.k) investigate the efficacy of 24-hour spill at John Day Dam, (1.l) evaluate the effect of spill duration and volume on spillway effectiveness and efficiency and forebay residence time of juvenile salmonids, (3.c) investigate tailrace hydraulic conditions through general model studies to determine optimum spill patterns that will minimize juvenile retention time in spill basins and tailraces and minimize adverse conditions for adult passage at all dams where this has not already been done, and (3.d) jointly investigate operational and structural gas abatement measures at Grand Coulee and Chief Joseph dams as part of a system-wide evaluation of gas abatement measures.

VI.A.2.b.2) Reduction of Adverse Effects of Barriers to Migration Through Juvenile Bypasses

Interim Measures in the 1995 FCRPS Biological Opinion Juvenile bypasses divert a proportion of the juveniles approaching turbine intakes into channels that route fish into holding areas for transportation or else route fish back to the river downstream of the dam. A number of elements of the RPA were implemented in an attempt to make this mitigation feature more effective. Some specific measures include: install extended-length screens at three projects to improve guidance into the bypasses (1995 RPA Measures 19 and 21) and relocate bypass outfalls at Bonneville Dam (1995 RPA Measure 23 -- the outfall at the Second Powerhouse was completed during 1999; relocation of the First Powerhouse outfall [1998 FCRPS Biological Assessment, Section 4.7.11] has been delayed pending evaluation of a prototype surface bypass system). Several other interim measures called for in the 1995 RPA have been deferred until after 1999.

Long-Term Measures in the 1995 FCRPS Biological Opinion Long-term measures include: investigate methods of bypassing surface-oriented juveniles, before they dive and approach turbine intakes (1995 RPA Measure 11); improve guidance at Bonneville Dam above current levels (1995 RPA Measure 12); improve the bypass and associated fish facility at Lower Granite Dam (1995 RPA Measure 20 - although this action was originally specified as interim, it has now been deferred until after 1999 [1998 FCRPS Biological Assessment, Section 4.7.8]); and design a juvenile bypass system for The Dalles Dam (1995 RPA Measure 24 - completion by 1999 is dependent upon results of prototype surface bypass/collector tests in 1998 [1998 FCRPS Biological Assessment, Section 4.7.12]).

VI.A.2.b.3). Reduction of Adverse Effects of Barriers to Migration Through Turbine Operations

Interim Measures in the 1995 and 1998 Supplemental FCRPS Biological Opinions The highest juvenile mortality is seen for passage through turbines (e.g., review in Whitney et al. 1997; Muir et al. 1997). Therefore, most measures to partially mitigate effects of dams attempt to pass juveniles through other routes, as described above. One method of reducing the mortality of those juveniles that do pass through turbines is to operate turbines near peak efficiency. The 1995 RPA Measure 6 requires that this occur during the salmon passage season. Term/condition (3.a) of the ITS in the 1998 supplemental opinion required the Action Agencies to update guidelines for operating turbines within 1% of peak efficiency before February 1st of each year.

Long-Term Measures in the 1998 Supplemental FCRPS Biological Opinion Several of the terms and conditions of the ITS address turbine survival: (1.d) continue the program to study hydraulic and behavioral aspects of turbine passage to facilitate the development of biologically-based turbine design and operating criteria, 11(1.e) design and implement a thorough investigation of the effects minimum gap runners on juvenile survival at Bonneville Dam Powerhouse One, and (2.I) design and implement a program to improve adult passage survival through turbines.

VI.A.2.b.4) Reduction of Adverse Effects of Barriers to Migration Through Adult Fishways and Extended Operation of Juvenile Bypasses to Reduce Adult Fallback

Interim Measures in the 1995 FCRPS Biological Opinion Ladders designed to reduce delay and facilitate adult passage are in place at all dams. Measures to improve the effectiveness of adult fishways include maintaining ladders in criteria for optimal fish passage during the passage season (1995 RPA Measure 7) and maintaining spare parts and back-up systems sufficient to ensure their proper operation (IT 15 and IT 16). Additionally, juvenile fish facilities are operated longer than necessary for juveniles, in order to protect adults from falling back at a project through turbines (1995 RPA Measure 8).

Long-Term Measures in the 1998 Supplemental FCRPS Biological Opinion Several of the terms and conditions of the ITS specifically address adult passage at FCRPS dams: (2.a) investigate the cause of "headburn" in adult salmonids and implement corrective measures, (2.c) develop means for the early detection of potential diffuser grating failures in adult collection channels and ladders, develop measures to improve the security of diffuser gratings in adult fishways, and develop an Emergency Response Plan for each project, (2.d) develop improved operations for main entrances to adult fishways to provide the best attraction conditions for adult migrants when reservoirs are held at minimum operating pool, (2.e) use information from previous and ongoing investigations to develop actions to correct adult steelhead holding and jumping in the ladders at John Day Dam, (2.f) investigate and implement measures to reduce adult fallback mortality, (2.g) investigate the problem of attraction and delay of adult fallbacks in specific parts of juvenile collection galleries at Ice Harbor and McNary dams, and (2.h) investigate measures to reduce adult fallback and mortality rates through the Bonneville Dam spillway.

VI.A.2.c. Specific Characteristics of Upper Columbia River Spring Chinook Salmon, Lower Columbia River Chinook Salmon, and Middle Columbia River Steelhead that Relate to Barriers to Migration

The NMFS previously determined that operation of the FCRPS according to the 1995 RPA and the 1998 supplemental biological opinion would not jeopardize the survival and recovery of listed SR spring/summer and fall chinook salmon, SR sockeye, SR steelhead, UCR steelhead, and LCR steelhead during the interim period. The purpose of this section is to determine whether the biological characteristics of the newly listed species that would be affected by barriers to migration (i.e., juvenile rearing strategy and run timing) differ from those previously described. If differences exist and are significant, do they indicate that additional protections for the newly listed species are required (i.e., beyond those specified in the 1995 RPA and 1998 supplemental biological opinion)?

VI.A.2.c.1) Upper Columbia River Spring Chinook Salmon, Lower Columbia River Chinook Salmon, and Middle Columbia River Steelhead

<u>Juvenile Rearing Strategies</u>

Juvenile rearing strategies (stream- and ocean-type) of the newly listed salmonid ESUs overlap with those for species considered in the 1995 RPA and 1998 supplemental biological opinion (Table VI-4). Thus, the developmental condition of smolts from the newly and previously-listed ESUs are likely to be similar. The NMFS believes that the structural and operational measures recommended in the 1995 RPA and 1998 supplemental biological opinion to avoid jeopardy for stream- and ocean-type ESUs due to barriers to migration are consistent with the biological requirements of these ESUs during the rest of the interim period.

<u>Timing of Juvenile Migration</u>

Observations from the smolt trap at Rock Island Dam indicate that the peak of the juvenile UCR spring chinook salmon migrate through the mid-Columbia reach during April through June (Table VI-1). A review of Smolt Monitoring Program index data for wild and hatchery UCR spring chinook salmon arriving at Rock Island Dam shows that, for the period 1992 through 1998, the mean date of arrival of at least 100 fish per day was April 8. Juvenile UCR spring chinook salmon are in the FCRPS action area during approximately the same period as juvenile UCR steelhead (mean date of arrival of at least 100 fish per day = April 3). Further, juveniles from this ESU are in the reach between McNary and Bonneville dams during the same period as Snake River spring/summer chinook and UCR steelhead (March through July).

Although the LCR chinook salmon ESU includes spawning populations which enter the mainstem Columbia River above Bonneville Dam (White Salmon and Klickitat rivers, Washington), no ESU-specific data are available for the migration timing of these populations at Bonneville Dam. The peak passage of juveniles from this ESU is assumed to occur during some portion of the migration period for the run at large (March through July, Table VI-1). Structural and operational measures recommended by NMFS in the 1995 RPA and 1998 supplemental biological opinion to avoid jeopardy for SR spring/summer chinook salmon, SR steelhead, and UCR steelhead (by avoiding barriers to migration) are consistent with the biological requirements of this ESU during the rest of the interim period.

Although no specific data are available for the migration timing of wild MCR steelhead at mainstem dams, juveniles from this ESU are assumed to be present during some portion of the migration of the run at large (April through June at McNary Dam, Table VI-1). Structural and operational measures recommended by NMFS in the 1995 RPA and 1998 supplemental biological opinion that avoid jeopardy for Snake River spring/summer chinook salmon, Snake River steelhead and UCR steelhead[12] (by avoiding barriers to migration) are consistent with the biological requirements of this ESU during the rest of the interim period.

Timing of Adult Migration

The adult migrations of UCR spring chinook salmon, LCR chinook salmon, and MCR steelhead overlap in time with those of species already considered in the 1995 RPA and 1998 supplemental biological opinion (Table VI-5). Therefore, the structural and operational measures recommended by NMFS in the 1995 RPA and 1998 supplemental biological opinion for avoiding jeopardy (by mitigating barriers to migration) are consistent with the biological requirements of these ESUs during the rest of the interim period.

VI.A.2.c.2) Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead

Upper Willamette River spring chinook salmon and UWR steelhead do not migrate past any FCRPS dams. Therefore, it is not necessary to develop mitigation measures for barriers to migration for these two ESUs in this supplemental biological opinion.

VI.A.2.c.3) Columbia River Chum Salmon

[12] At least two measures in the 1998 supplemental biological opinion specifically addressed the survival of steelhead kelts. Term/condition "2.b" of the ITS required studies of dam passage and survival. Term/condition "2.f" required an evaluation of the season during which bypass screens are deployed, especially at McNary and John Day dams. With respect to the dam passage and survival studies, the Corps of Engineers funded studies this year at Lower Granite Dam, performed by the Columbia River Intertribal Fish Commission (CRITFC). The Corps plans to expand the CRITFC study to four lower Snake and lower Columbia river projects during 2000.

Adult Passage

Chum salmon are believed to spawn primarily in the lower reaches of rivers because they show little persistence in surmounting in-river blockages and falls. Fulton (1970) reported that chum salmon spawned upstream from Bonneville, as far as The Dalles Dam, as recently as a few decades ago. There are even reports that chum salmon spawned in the Umatilla and Walla Walla Rivers, more than 310 miles (500 km) from the sea (Nehlsen et al. 1991). But these fish would have passed Celilo Falls, a web of rapids and cascades, presumably passable by chum salmon only under high flow events during their migration period, late fall and early winter.

The current extent of spawning by CR chum salmon, and thus the effect of Bonneville Dam as a barrier to migration, is unknown. Adult chum salmon are known to show little persistence in surmounting river blockages and falls (63 FR 11775). The 10-year average (1989 through 1998) count for the fish ladders at Bonneville Dam was 56 adults (Table VI-6), although this statistic is heavily skewed by a high count of 285 chum salmon in 1998 (J. Loch, WDFW, unpubl. data[13]). Without the 1998 data, the nine-year average would be only 31 adult chum. The NMFS considers these data on chum salmon passage at Bonneville Dam extremely important given the implications for spawning in Bonneville pool (i.e., and for reservoir operations that may affect spawning habitat once these areas are identified).

VI.A.3. Combined Effects of Water Regulation, Impoundment, and Barriers to Migration With Respect to Biological Requirements Within the Action Area

VI.A.3.a. Combined Effects of Water Regulation, Impoundment, and Barriers to Migration With Respect to Biological Requirements Within the Action Area

The effects previously described in Sections VI.A.1 and VI.A.2 describe the impact of the proposed actions on action-area biological requirements. Additional impacts resulting from the combined effects of water regulation, impoundment, and barriers to migration are not apparent.

VI.A.3.b. Reduction of Adverse Combined Effects of Water Regulation, Impoundment, and Barriers to Migration Through Proposed Measures

VI.A.3.b.1) Reduction of Adverse Combined Effects of Water Regulation, Impoundment, and Barriers to Migration Through Transportation of Juveniles

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[13] The unusually high count during 1998 was due to (1) an increase in the effort applied to interrogating the video tapes for observations of chum salmon and (2) unusually high activity in the fish ladders at night, possibly related to unusual temperature conditions in Bonneville pool (pers. comm., J. Loch, WDFW, January 28, 2000).

Most studies indicate that juvenile chinook salmon and steelhead transported from the lower Snake River return at a higher rate than in-river control fish similarly collected and marked, but allowed to continue their migration in-river under the current hydrosystem configuration (reviewed in NMFS' 1998 Supplemental FCRPS Biological Opinion, Appendix B). However, there is continuing controversy regarding the application of these results to mitigation measures that affect in-river fish runs, which are not collected and handled in the same manner as the experimental controls. Additionally, concerns regarding the lack of information on population-specific effects of transportation, relative to in-river migration under current conditions, prompted the Independent Scientific Advisory Board (ISAB 1998) to recommend a "spread-the-risk" policy. In the 1998 supplemental biological opinion, NMFS addressed this recommendation by increasing spill at collector projects.

<u>Interim Actions in the 1995 and 1998 Supplemental FCRPS Biological Opinions</u> The 1995 RPA Measure 3 required transportation around reservoirs and dams of most chinook and sockeye salmon, to avoid mortality associated with impoundment and dam passage. The TMT was given flexibility to reduce the percentage of juveniles transported from a given project under some circumstances (e.g., by spilling at collector projects at flow levels below triggers [1995 RPA Measure 2] or by returning collected fish to the river [1995 RPA Measure 3]). The 1995 RPA Measure 3 concluded that, for McNary Dam, "there is sufficient uncertainty regarding benefits of transported yearling salmon to warrant suspending transport from that site during the spring." The 1995 RPA Measure 9 specified that barge exits should be enlarged to facilitate passage of transported juveniles from barges and 1995 RPA Measure 25 specified that new barges should be constructed to reduce holding time of juveniles prior to barging. IT 8 required a study of short-haul barging operations.

The proposed action in the 1998 biological opinion included various measures designed to adopt the ISAB's (1998) recommendation to "spread-the-risk" among transportation and in-river migration for listed spawning populations and to reduce the proportion of fish transported by truck. The 1995 RPA Measure 3 would also be modified to allow an experiment involving spring transportation from McNary Dam in 1999 or future years. The immediate purpose of the experiment would be to evaluate the apparent high mortality of transported yearling chinook salmon from this project as determined from PIT-tag detections, with the intention of identifying means by which the problem can be corrected. The ultimate purpose of the experiment would be to allow future transportation of UCR steelhead from McNary Dam in order to spread the risk between transportation and in-river migration for this ESU.

Due to their migration timing, some UCR spring chinook salmon are likely to be collected with SR fall chinook salmon at McNary Dam and transported around the lower Columbia River dams. Collection and transport is considered an incidental take because transportation is not intended as an enhancement measure for this ESU. Historical passage patterns for UCR spring chinook salmon (Rock Island Dam fish trap index counts, 1985 through 1998) show that, on average, the 95th percentile of the spring chinook salmon run has passed McNary Dam within two days of the transportation planning date (June 20th; as described on page III-9 of the 1998 Supplemental FCRPS Biological Opinion) (Figure VI-

4)[14]. Based on these data, and the ability to make real-time operational decisions through the in-season management process, NMFS would not expect transportation of UCR spring chinook salmon from McNary Dam to adversely affect this ESU during the rest of the interim period.

Similarly, MCR steelhead emerging from the Yakima River subbasin may be collected with SR fall chinook at McNary Dam. Collection and transport is also considered an incidental take for this species, as described for UCR spring chinook salmon, above. There is no information on historical passage patterns for MCR steelhead; these fish do not pass Rock Island Dam so there are no index counts from that smolt trap. However, if the passage timing of steelhead smolts originating in the Yakima subbasin at McNary Dam is assumed similar to that of smolts from the UCR steelhead ESU (Figure VI-5), on average over the years 1985 through 1998, the 95th percentile passed McNary Dam five days before the June 20th transportation planning date[15]. Based on this information, NMFS would not expect transportation of MCR steelhead from McNary Dam to adversely affect this ESU during the rest of the interim period.

Long-Term Action in the 1995 FCRPS Biological Opinion Some of the elements described in the interim action also continue as long-term actions (e.g., construction of new barges). Additionally, maximum transportation is considered one of the two major pathways for system operation that may be adopted upon reinitiation of consultation. Model analyses in the 1995 FCRPS biological opinion indicated that under assumptions of a weak flow:survival relationship and high post-Bonneville survival of transported fish, survival and recovery of listed Snake River chinook spawning populations is possible by maximizing transportation. Several of the elements associated with long-term bypass improvements (Section VI.A.2), including development of surface bypass/collectors to improve collection of fish for transportation at some projects and improve in-river survival of uncollected fish at others, also support the long-term transportation option.

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[14] This statement is based on daily passage indices at Rock Island Dam (Chelan County Public Utility District No. 1, unpublished data [Excel spreadsheet: \85-99ris.xls]), assuming a 12-day travel time from Rock Island to McNary Dam (Giorgi et al. 1997). Giorgi et al. (1997) reported an average speed for spring chinook salmon from Rock Island Dam to McNary dam (260 km; 161 miles) of 21.5 km/day (13.4 mi/day). The distance between Rock Island and McNary dams is 260 km (161 miles). Therefore, UCR spring chinook salmon are estimated to travel this distance in approximately 12 days (260 km/21.5 km per day or 161 mi/13.4 mi per day).

Passage indices are for both hatchery and “unknown” yearling chinook; not all fish released from hatcheries in the upper Columbia basin are adipose-fin clipped. Therefore, some hatchery releases of summer chinook may be included in the run with the effect of extending the tail later in the season.

[15] This statement assumes a 9-day passage time from Rock Island to McNary Dam (Giorgi et al. 1997). Giorgi et al. (1997) reported an average speed for steelhead from Rock Island Dam to McNary Dam of 30.4 km/day). Therefore, UCR steelhead are estimated to travel this distance in approximately 9 days (260 km/30.4 km per day).

VI.A.3.b.2) Reduction of Adverse Combined Effects of Water Regulation, Impoundment, and Barriers to Migration Through Natural River Drawdown

Breaching dams and lowering reservoirs to natural (pre-impoundment) river levels have the potential to reduce adverse effects at the specific projects that are breached. Some level of mortality, above pre-impoundment natural mortality, may still be associated with natural river drawdowns because some period of time may be required for sediment to be flushed, natural channel conditions to stabilize, and predator populations to adjust to new habitat conditions. There may also be additional adverse effects associated with removing collector projects, because juveniles previously placed on barges would now have to migrate through four lower river dams and reservoirs that are currently avoided by transported fish.

Long-Term Actions in the 1995 and 1998 Supplemental FCRPS Biological Opinions The 1995 RPA Measure 10 requires that the Corps complete necessary feasibility, design and engineering work to allow drawdown of Snake River reservoirs to begin by 2000. Modeling analyses described in the 1995 FCRPS biological opinion concluded that under assumptions of a strong flow:survival relationship and poor survival of transported fish below Bonneville Dam, drawdown of four Snake River reservoirs was necessary to ensure survival and recovery of listed Snake River salmon.

As described in Section IV.A.1.b.2), the proposed action in the 1998 opinion included a feasibility study to determine the best long-term configuration and operation of the FCRPS in the lower Columbia River. The Corps sought appropriations to initiate the feasibility study. However, although Congress approved funds for the Phase I study of a John Day drawdown in the Conference Report on the Energy and Water Development Appropriations Act for 2000, it prohibited the Corps from using any appropriation found in the act to initiate a study of the drawdown at McNary Dam unless authorized by law. The significance of this restriction will be addressed in the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

VI.A.4. Species-Level Effects of the Proposed Action

Until life-cycle analyses have been completed, it is not possible to demonstrate quantitatively whether any of the newly-listed species can be expected to survive with an adequate potential for recovery under the interim action. However, because the biological requirements of four of the newly listed species (UCR spring chinook salmon, MCR steelhead, UWR chinook salmon, and UWR steelhead) in the action area substantially overlap with those of species considered in the 1995 and 1998 biological opinions, and because NMFS concluded that the interim operation would not jeopardize those species, it is reasonable to conclude that the species-level biological requirements of these four species would also be met during the rest of the interim period.

To the extent that a fifth species (LCR chinook salmon) uses the action area as a migration corridor, the biological requirements of this species also substantially overlap with those of species considered in the 1995 and 1998 biological opinions. However, the fall-run ("tule") component of the ESU may also require attributes associated with spawning, incubation, emergence, and rearing in the Ives Island area below Bonneville Dam. Studies to address the importance of the Ives Island spawners to the genetic and life-history diversity of the ESU will be critical to a quantitative evaluation of the effects of any proposed long-term FCRPS operation on the survival and recovery of LCR chinook salmon. The Action Agencies have proposed to gather information on the hatchery versus wild origin of these tule fall chinook during the interim period. This information will contribute to the development of the best operation (i.e., interim and long-term operations) during the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

The Action Agencies have proposed to manage storage with natural runoff to give CR chum salmon access to spawning habitat in the Ives Island area, to protect redds from dewatering during incubation, and to maintain connectivity between spawning areas and the mainstem Columbia River during emergence[16]. Studies to address the importance of the Ives Island spawners to the genetic and life-history diversity of the ESU will be critical to a quantitative evaluation of the effect of any proposed long-term FCRPS operation on the survival and recovery of CR chum salmon. The Action Agencies will gather the information needed to make this determination during the interim period so that the best operation (interim and long-term) can be developed during the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

VI.A.5. Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation."[17] There are no non-Federal activities that meet this definition and that are relevant to this consultation. The NMFS assumes that any such activities will continue as under the environmental baseline.

Future Federal actions, including the ongoing operation of hatcheries, fisheries, and land management activities, are being or have been reviewed through separate Section 7 consultation processes.

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[16] i.e., when the operation can be performed without adverse effect on implementation of the 1995 RPA, the 1998 supplemental biological opinion, or the ability of parties to comply with the Vernita Bar agreement (Section III.A.2).

[17] For the purposes of this analysis, the action area encompasses the Snake and Columbia rivers, including areas outside the range of listed UCR spring chinook salmon, LCR chinook salmon, MCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon that affect natural runoff of water into those areas that are within the listed species' range.

VII. CRITICAL HABITAT

As described in Section V of this biological opinion, operation of the FCRPS may affect essential features of the migration corridors of the newly listed species by (1) reducing water velocity due to water storage; (2) modifying passage conditions due to the placement of dams, routing of a proportion of fish through turbines and creating microhabitats preferred by some predators; (3) modifying water quality through gas supersaturation; and (4) increasing water temperatures. Operation of the FCRPS may affect essential features of their spawning and rearing habitat by altering the runoff patterns and baseflows that would otherwise (1) provide access to some quantity of spawning habitat and (2) maintain connectivity between spawning habitat and the mainstem migration corridor. The analyses of the previous sections relate these changes in critical habitat to changes in the survival of listed salmonids in the mainstem Columbia River.

The analysis of whether the proposed action jeopardizes listed salmonids (appreciably reduces the likelihood of both survival and recovery of the listed species) encompasses the closely related determination of whether that operation adversely modifies or destroys the listed species' critical habitat (appreciably diminishes the value of critical habitat for both the survival and recovery of the listed species). In other words, in evaluating the relationship between the proposed action and the expected survival and productivity of the newly-listed species of salmon and steelhead (Section VI), the NMFS combines determinations of adverse modification of critical habitat and jeopardy into one analysis.

The NMFS has proposed critical habitat designations for each of the newly listed species (see 64 FR 14598 for UCR spring chinook, LCR chinook, and UWR chinook salmon; 64 FR 5740 for MCR and UWR steelhead; and 64 FR 11774 for CR chum salmon). However, in each case, the NMFS determined that a final critical habitat designation could not be made at the time of listing. The NMFS therefore extended the deadline for designating critical habitat. Final critical habitat has not been designated.

VIII. CONCLUSIONS

VIII.A. Upper Columbia River Chinook Salmon and Middle Columbia River Steelhead

As described in Section V, the biological requirements of the UCR spring chinook salmon and MCR steelhead within the action area are very similar to those of the Snake River and Upper Columbia River chinook salmon and steelhead ESUs considered in the 1995 RPA and 1998 supplemental biological opinion. Because of substantial overlap in the timing and distribution in the action area of the newly-listed species, and similar effects of proposed FCRPS operations on their survival, NMFS concludes that the action proposed for the rest of the interim period (from the date this biological opinion is signed until it is superceded by the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999) is not likely to jeopardize the continued existence of UCR spring chinook salmon or MCR steelhead or to adversely modify proposed critical habitat. The Action Agencies' proposal to develop tools for quantitative analyses for these ESUs before the next FCRPS consultation will be critical to a determination of the effects of the proposed long-term operation.

VIII.B. Lower Columbia River Chinook Salmon

Individuals from this ESU pass only one FCRPS project and are primarily affected by Federal water management in the mainstem Columbia River. The biological requirements of LCR chinook salmon with respect to use of the portion of the action area downstream from the Wind and Hood rivers as a migration corridor are very similar to those of the SR fall chinook salmon ESU (considered in the 1995 RPA and 1998 supplemental biological opinion) in the same portion of the action area. Because of the similar timing and distribution in the lower Columbia River of migrating juvenile LCR chinook salmon, and similar effects of proposed FCRPS operations on the survival of these life stages, NMFS concludes that the measures set forth in the 1995 RPA and 1998 supplemental biological opinion for SR will provide similar levels of protection for LCR chinook salmon.

However, LCR chinook salmon also have spawning and early rearing requirements that differ from those of the species considered in the 1995 and 1998 biological opinions; uncertainties about the species biological requirements in this portion of its life history will be addressed by studies proposed during the interim period (see Section III.B). The NMFS believes that the Action Agencies' proposed action, including securing genetic information to evaluate the importance of the Ives Island spawners to the viability of the ESU, is consistent with the biological requirements of LCR chinook salmon and is not likely to jeopardize the continued existence of this ESU during the rest of the interim period nor to adversely modify proposed critical habitat. In part, this determination is based on the conclusions of the Biological Review Team (BRT) that LCR chinook salmon are not presently in danger of extinction (although likely to become so in the foreseeable future) and the observations that the hydrosystem was not managed to provide or stabilize fall spawning and winter incubation flows in the Ives Island area before 1997.

VIII.C. Upper Willamette River Chinook Salmon and Upper Willamette River Steelhead

Because there is no direct measure of mortality due to conditions in the Columbia River estuary, plume, and nearshore ocean environment, the effects of FCRPS operations cannot be quantified. Based upon the best science available and its professional judgement, NMFS does not have reason to expect that adverse effects on these UWR spawning populations will result from FCRPS water management in the mainstem Columbia River under the 1995 RPA and 1998 supplemental biological opinion. Nor does NMFS have reason to expect that the Action Agencies proposed action is likely to jeopardize the continued existence of UWR chinook salmon or UWR steelhead for the rest of the interim period[18] or to adversely modify proposed critical habitat.

VIII.D. Columbia River Chum Salmon

As described above, the use of reservoir storage to support chum salmon spawning in the Ives Island area in November through January, and incubation and emergence through winter and early spring, would have an adverse effect on the likelihood that Grand Coulee would refill to upper rule curve by April 10 in many water years. In the chum salmon status review (Johnson et al. 1997), the NMFS reported the Biological Review Team's conclusion that CR chum salmon are presently at significant risk of extinction, although team members were divided in their opinions of the severity of that risk. Current abundance is probably less than 1% of historical levels and much of the original population-level diversity has presumably been lost. However, the abundance of the CR chum salmon ESU has been stable for several decades (albeit at a very low level, Figure VI-6). Given that the hydrosystem was not managed to provide or stabilize fall spawning or winter incubation flows in the Ives Island area before 1997, the NMFS believes that the Action Agencies' proposed action, including securing information on rates of exchange between spawning aggregations and on geographic distribution, for evaluating the importance of the Ives Island spawning aggregation to the viability of the ESU, is consistent with the biological requirements of CR chum salmon and is not likely to jeopardize the continued existence of this ESU during the rest of the interim period or to adversely modify proposed critical habitat.

[18] i.e., from the date this biological opinion is signed until it is superceded by the broader consultation on the effects of long-term FCRPS operations on all listed salmonids, which was reinitiated with receipt of the Action Agencies' Biological Assessment on December 17, 1999.

IX. CONSERVATION RECOMMENDATIONS

Section 7 (a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and listed species. Conservation recommendations are discretionary measures suggested to minimize or avoid the potential adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, to develop additional information, or to assist the federal agencies in complying with the obligations under section 7(a)(1) of the ESA. The NMFS believes that the following conservation recommendations, supplemental to those stated in the 1995 and 1998 biological opinions, are consistent with these obligations and therefore supports their implementation by the Action Agencies.

Spawning Habitat for Listed LCR Chinook Salmon in the Ives Island Area Below Bonneville Dam

As described in Section VI.A.1, field biologists from ODFW, WDFW, and USFWS observed tule fall chinook salmon spawning in the area around Ives and Pierce islands during the first three weeks of October 1999. These findings imply that the flow augmentation program described in Section III.A.2 to benefit CR chum salmon should be started approximately four weeks earlier to provide LCR fall chinook salmon access to spawning habitat in the Ives Island area. However, the NMFS is concerned about the ability of the hydrosystem to sustain this operation, either this year or during an average water year (i.e., one that begins with less water in storage than 1999), without adverse effect on the operations specified in the 1995 RPA and 1998 supplemental biological opinion. Given that there is uncertainty about the wild versus hatchery origin of the "tule" fall chinook spawning below Bonneville Dam and the effect of wild-spawning hatchery fish on the status of the ESU (Section VI.A.1), the NMFS recommends that the Action Agencies provide flow augmentation for access to spawning habitat in the Ives Island area as early as the first week in October if the hydroregulation studies completed by the middle of the previous month (September) indicate that the operation will not add significant risk to the operations specified in the 1995 RPA and 1998 supplemental biological opinion.

X. REINIATION OF CONSULTATION

Consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; new information reveals effects of the action may affect listed species in a way not previously considered; the action is modified in a way that causes an effect on listed species that was not previously considered; or, a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

These general conditions apply as well to prospective agreements, plans and contracts ("prospective agreements") that the Action Agencies use to plan for operation of or to actually operate the FCRPS and to coordinate operations with Canada and regional utilities. Examples include implementation of the Columbia River Treaty (Treaty) between the United States and Canada, such as by the adoption of assured operating plans and detailed operating plans; arrangements with Canada for Non-Treaty storage; and renewing and revising the Pacific Northwest Coordination Agreement.

To the extent that the prospective agreements are used to achieve operations that are in accordance with this Supplemental FCRPS Biological Opinion, including the reasonable and prudent measures and the terms and conditions, the effects of those prospective agreements on Snake River salmon have been considered in this Supplemental FCRPS Biological Opinion. To the extent that proposed agreements have effects on FCRPS operations that affect listed fish in ways not considered in the supplemental opinion, or have provisions that go beyond implementing the operations specified in the supplemental opinion, those proposed actions may require separate consultation or reinitiation of this consultation.

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XII. INCIDENTAL TAKE STATEMENT

Section 9 and regulations implementing Section 4 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. When a proposed federal action is found to be consistent with Section 7 (a)(2) of the ESA (i.e., the action is found not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat) and that action may incidentally take individuals of listed species, NMFS will issue an incidental take statement specifying the impact of any incidental taking of endangered or threatened species.

The incidental take statement also provides reasonable and prudent measures that are necessary to minimize impacts, and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. Incidental takings resulting from the agency action, including incidental takings caused by activities authorized by the agency, are exempted from the taking prohibition by Section 7(o) of the ESA, but only if those takings are in compliance with the specified terms and conditions and shall be applied in full effect to the newly listed species (UCR spring chinook salmon, LCR chinook salmon, MCR steelhead, UWR chinook salmon, UWR steelhead, and CR chum salmon).

This incidental take statement supplements the reasonable and prudent measures and terms and conditions in the 1995 and 1998 supplemental FCRPS biological opinions. The 1995 and 1998 incidental take statements shall continue in full effect except to the extent that this supplemental incidental take statement changes particular measures or establishes additional measures.

Upper Columbia River Spring Chinook Salmon

The approximate mortality of upstream-migrating adult UCR spring chinook salmon through the four lower Columbia River FCRPS projects is not expected to exceed 12% (based on an estimated 88% survival from Table VI-6 in NMFS' 1998 Supplemental FCRPS Biological Opinion). The expected mortality of migrating juvenile UCR spring chinook salmon over the four project (McNary to Bonneville) reach is approximately 23% to 44% (86% to 94% per-project survival rate; depending on survival conditions; Table 11 in NMFS 1999d).

To the extent that some UCR spring chinook salmon are transported from McNary Dam (see Section VI.A.3 and Figure VI-4), direct mortality for this component of the run is expected to be less than 23% to 44%. This estimate does not include any potential indirect mortality of transported UCR spring chinook salmon after they are released below Bonneville Dam (currently unquantified).

Lower Columbia River Chinook Salmon

An unknown proportion of LCR chinook salmon migrate past Bonneville Dam. The respective mortality rates of the spring and fall components of the ESU under the interim operation are unknown. However, the juvenile mortality rate of the spring-run component is expected to be similar to the per-project mortality rate estimated for UCR spring chinook salmon, above (7% to 14%). The adult mortality rate of the spring-run component is also expected to be similar to the per-project mortality rate estimated for UCR spring chinook salmon (3%). Both of these mortality rates are lower than the corresponding estimates for SR spring/summer chinook salmon over a single-project reach (3% for adults and up to 18% for juveniles) from data described in the 1995 FCRPS Biological Opinion.

Absent independent assessments for this component of the LCR chinook salmon ESU, the per-project mortality rates of the fall-run component are expected to be similar to those estimated for SR fall chinook salmon (6% for adults and 8% to 61% for juveniles, Figure 4.2-2 in Peters et al. 1999).

Middle Columbia River Steelhead

Migrating MCR steelhead pass up to four Federal projects. The mortality rate of adult steelhead over the four-project reach between Bonneville and McNary dams is expected to be similar to that estimated for UCR steelhead in the 1998 FCRPS Biological Opinion (5%). The mortality rate of juvenile MCR steelhead over the four-project reach is approximately 27% to 38% (from a 89% to 92% per-project survival rate; Table 11 in NMFS 1999d). The mortality of downstream migrating adult kelts resulting from the operation of the Columbia River projects is unknown but is the subject of research specified in the 1998 supplemental biological opinion.

To the extent that some MCR steelhead are transported from McNary Dam (see Section VI.A.3), direct mortality for this component of the run is expected to be less than 27% to 38%. This estimate does not include any indirect mortality of transported MCR steelhead after they are released below Bonneville Dam, currently unquantified.

Upper Willamette River Chinook and Upper Willamette River Steelhead

Upper Willamette River chinook and steelhead do not pass any FCRPS dams or reservoirs. Although survival is affected by FCRPS water management, the mortality of adults and juveniles from these two ESUs is unquantifiable. As long as fish protection measures are provided as described in the 1995 RPA and the proposed actions in the 1998 and this 2000 supplemental biological opinion, the resulting level of incidental take is authorized.

Columbia River Chum Salmon

As described in Sections III and VI, information on the geographic distribution of spawning aggregations of CR chum salmon is incomplete. Although the number of adult chum salmon in the fish ladders at Bonneville Dam each year is reported in the Corps Annual Fish Passage Reports, the mortality of either adults or juveniles resulting from project passage cannot be quantified at this time. Some or all of the redds built in the Ives Island area may become dewatered due to FCRPS water management. However, as long as fish protection measures are provided as described in the 1995 RPA and the proposed actions in the 1998 and this 2000 supplemental biological opinion, the resulting level of incidental take is authorized.

XII.A Terms and Conditions

The Action Agencies shall continue to coordinate through the Regional Forum the necessary evaluations and actions contained in the following terms and conditions of the ITS. If implementation of these terms and conditions is delayed or deferred, the Action Agencies and NMFS shall then determine whether further consultation is required through the Framework process set up by 1995 RPA measure 26. As a result of this determination, the terms and conditions may subsequently be modified.

XII.A.1 Terms and Conditions to Reduce the Mortality of Juvenile CR Chum Salmon

1. As a term/condition of this incidental take statement, the Action Agencies shall provide minimum instantaneous outflows from Bonneville Dam that create water depth over chinook and chum salmon redds in the Ives Island area sufficient to maintain an effective total dissolved gas (TDG) concentration no higher than 105% of saturation at the highest redd established by January 15th. Depth compensation is equal to 10% reduction in TDG for each meter of water depth (Weitkamp and Katz 1980). For example, if TDG measured in the water over the highest redds is 115%, there must be at least one meter of water covering the redds to give an effective TDG of 105% at the redd level. The Action Agencies shall consult with NMFS if conflicts between project operations, including the ability of parties to comply with the terms of the 1995 RPA and the 1998 Supplemental FCRPS Biological Opinion, and dissolved gas exposure are likely to occur. Potential risks to the susceptible life-history stage of listed species will be considered in season by the TMT, which will recommend measures to reduce these risks.

Chinook and chum salmon are particularly vulnerable to gas bubble disease during the yolk sac fry stage, primarily late February through April.[19] Operations at lower Columbia River hydrosystem projects can create elevated levels of total dissolved gas high enough to kill yolk sac fry. Examples of

[19] Once the yolk is fully absorbed and the body cavity has "buttoned up", fry are generally very tolerant to high dissolved gas concentrations.

these operations include spill for debris removal or gas generation and abatement testing and spill to aid passage of salmon smolts (e.g., March releases from Spring Creek NFH). Other dam operations, maintenance, and research activities which reduce powerhouse capacity and force spill to occur in high enough amounts that high concentrations of total dissolved gas are generated must be scheduled outside the period when yolk sac fry are in the redds or implemented such that redd-level gas concentrations do not exceed 105%.

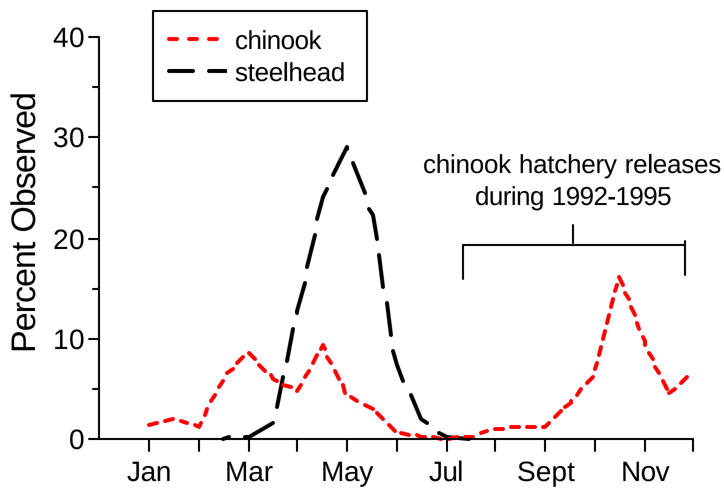


Figure VI-1. Index of juvenile migration timing: average percent number of wild chinook salmon and steelhead in Portland General Electric's (PGE) Sullivan Plant fish trap (Willamette Falls, Oregon). Catch by two-week period during 1992 through 1997. Secondary (Oct/Nov) peak of wild chinook salmon due to hatchery releases during 1992 through 1995). Data from Cramer and Domina (1998). Information regarding hatchery releases comprising the secondary peak for juvenile chinook salmon: pers. comm., D. Domina, Fishery Biologist, PGE, June 23, 1999.

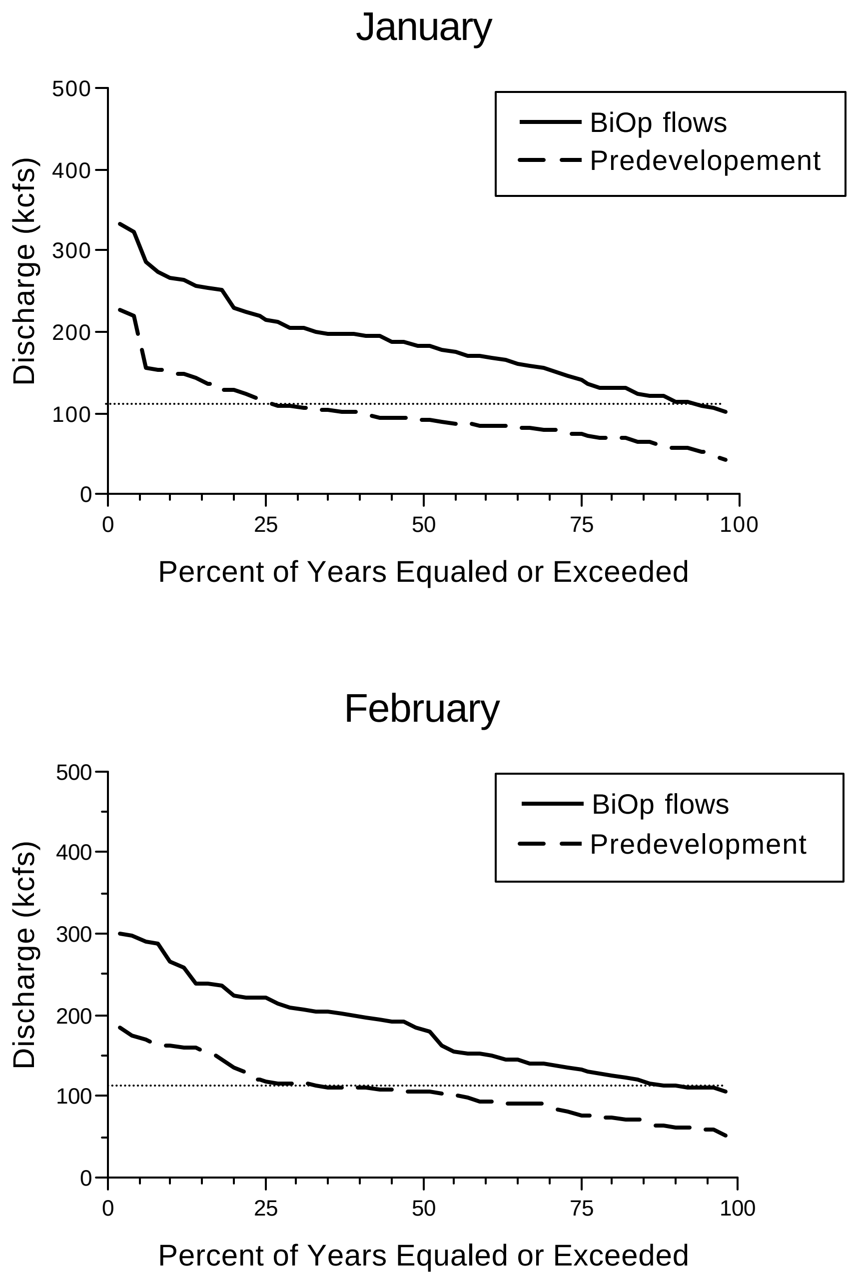


Figure VI-2: Average monthly flows at Bonneville Dam during January and February per requirements of the 1995 FCRPS Biological Opinion (BiOp flows) and during the predevelopment period (BoR 1999). The predevelopment condition represents a Columbia River system that existed before irrigation development began in the mid-1800s.

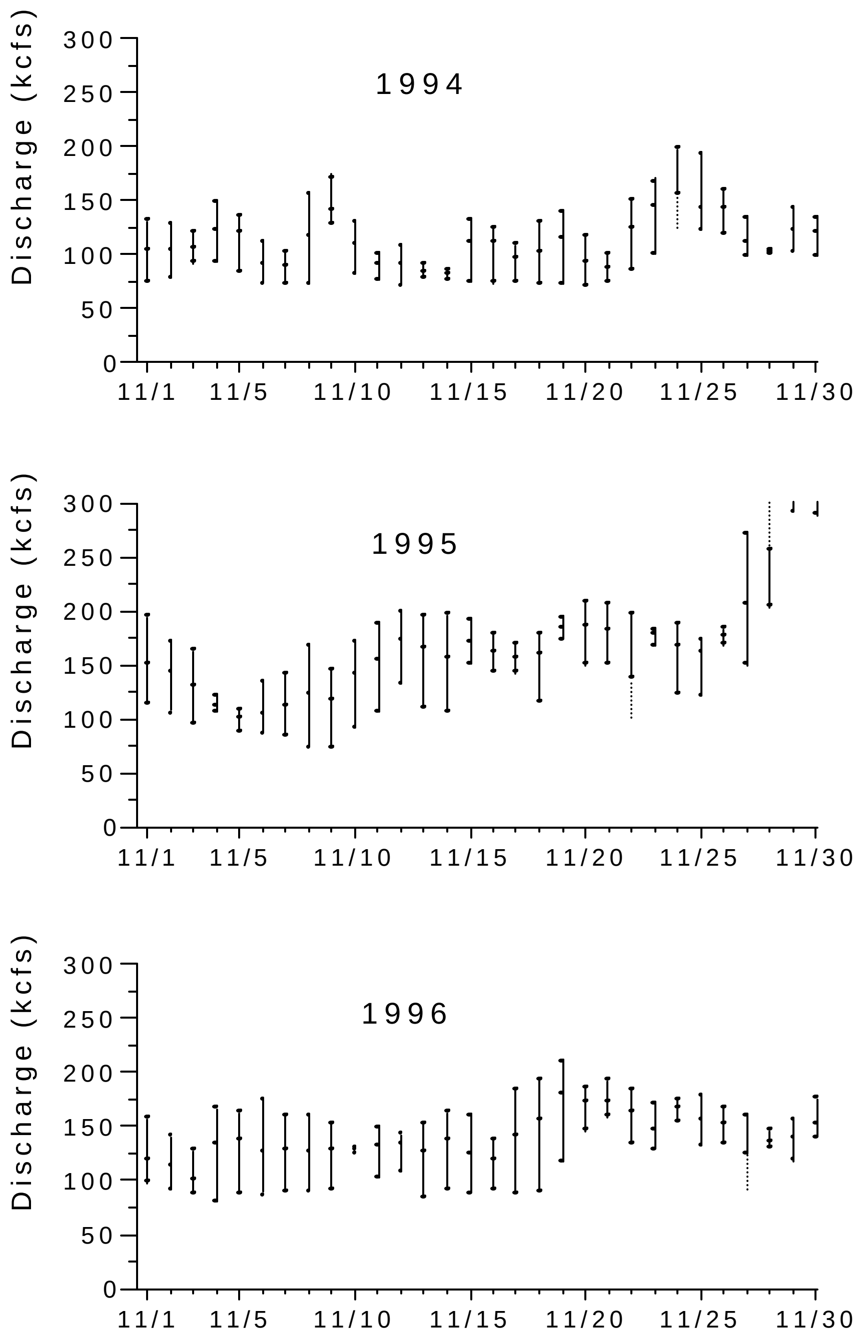
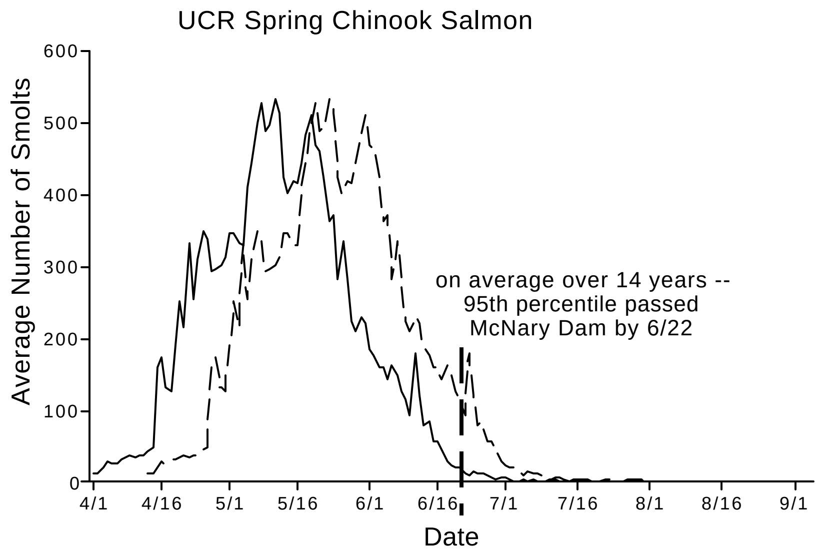


Figure VI-3. Daily average, maximum, and minimum Bonneville outflows during November 1994, 1995, and 1996. Daily range (= max - min) prior to operation of the hydrosystem to support spawning in the Ives Island area was typically greater than 10 kcfs (source: Excel spreadsheet titled \bonflow.xls, BPA).



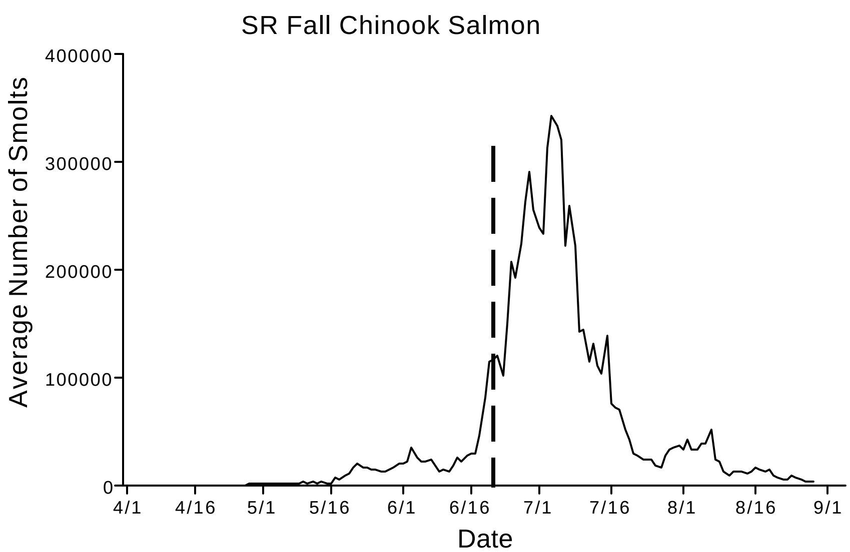
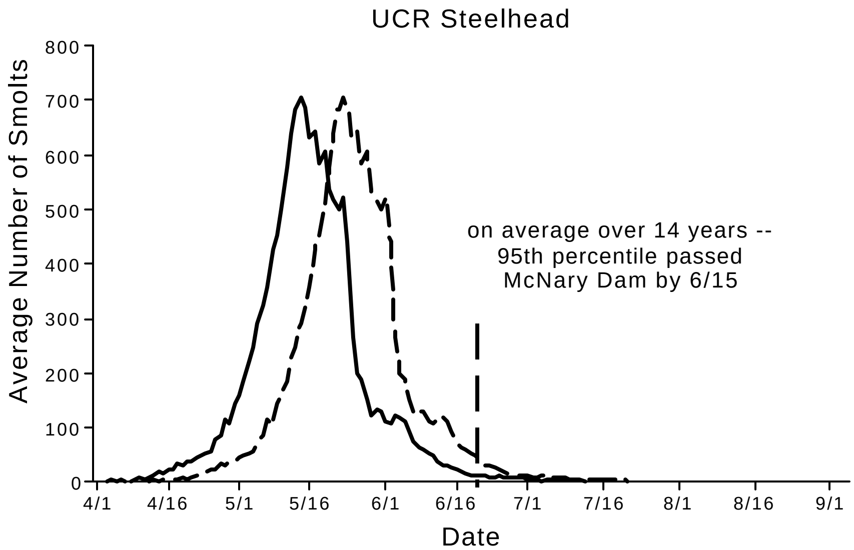


Figure VI-4. Historical average daily passage indices for UCR spring chinook salmon (hatchery and "unknown"; not all hatchery fish are adipose-fin clipped) at Rock Island and McNary dams, 1985-1998 (upper graph; pers. comm. [E-mail] K. Hampton, Chelan County PUD No.1, September 2, 1999), and fall chinook salmon at McNary Dam (lower graph; Columbia River DART, smolt index page: http://www.cqs.washington.edu/dart/pass_com.html). Dashed curve in upper graph projects arrival of UCR spring chinook salmon at McNary Dam, delayed by 12 days for travel time from Rock Island Dam (see text). Vertical dotted line shows transportation planning date of June 20th.



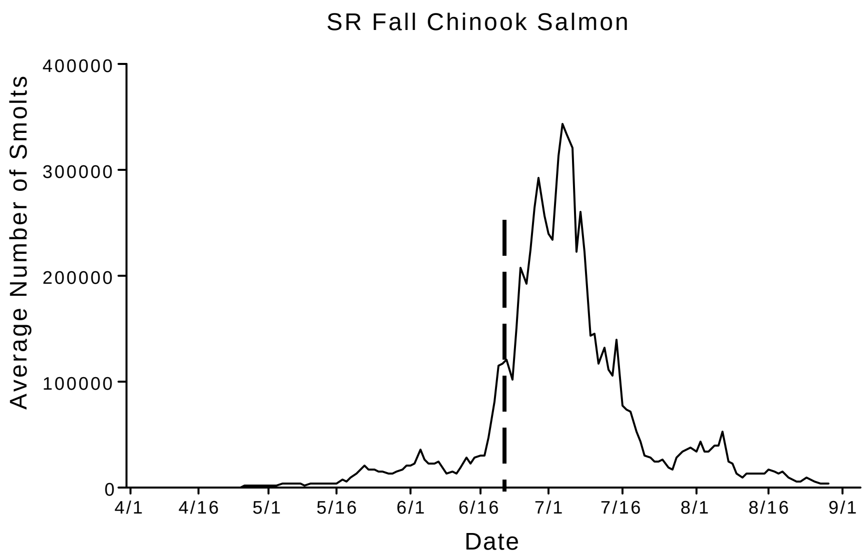


Figure VI-5. Historical average daily passage indices for wild UCR steelhead at Rock Island and McNary dams, 1985-1998 (upper graph; pers. comm. [E-mail] K. Hampton, Chelan County PUD No.1, September 2, 1999), and fall chinook salmon at McNary Dam (lower graph; Columbia River DART, smolt index page: http://www.cqs.washington.edu/dart/pass_com.html). Dashed curve in upper graph projects arrival of UCR steelhead at McNary Dam, delayed by 9 days for travel time from Rock Island Dam (see text). Vertical dotted line shows transportation planning date of June 20th.

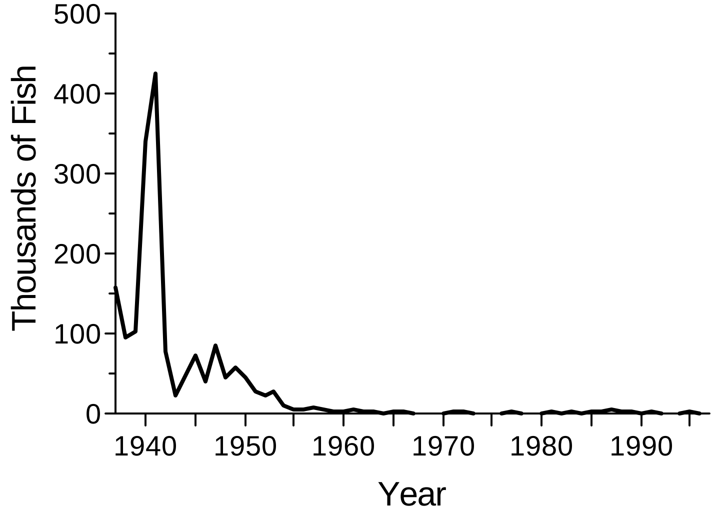


Figure VI-6. Minimal run size for chum salmon, 1938 to 1994, in the Columbia River, calculated by summing harvest, spawner surveys, and Bonneville Dam counts. Data from ODFW and WDFW (1998).

Table III-1. Minimum instantaneous Bonneville Dam outflows to provide access to and maintain adequate depth of cover over CR chum salmon spawning areas in the Ives Island area below Bonneville Dam.			
Date Range	**Function**	**Estimate of Total Habitat Available**[1]	**Outflow**[2]
Oct 15 - Nov 15, 1999	Access to some spawning habitat in Hamilton Slough and in Hamilton Creek (as chum begin to stage).	50%	125 kcfs
Nov 16 - 30, 1999	Access to additional habitat[3] during peak spawning and adequate water depth (1 foot) over available habitat.	70%	140-145 kcfs
Dec 1 - 31, 1999	Access to additional habitat as spawning continues and adequate water depth (1 foot) over available habitat.	100%	155-160 kcfs
Jan 1 - Apr 20, 2000	Adequate water depth over redds (0.5 foot) during incubation and emergence.[4]	100%	150 kcfs

[1] Based on an estimate of the total amount of spawning habitat used during 1998 (ODFW et al. 1999).

[2] Flow requirements assume that chum salmon require 1-foot of water over gravel for spawning purposes and 0.5-foot of water during incubation. Requirements are based on recommendations developed by ODFW et al. (1999): Fall chinook and chum salmon spawning in the mainstem Columbia River below Bonneville Dam Fact Sheet (September 2, 1999 Addendum) from observations of index redds during 1998.

[3] Additional habitat during peak spawning would reduce superimposition of chum salmon redds.

[4] When necessary to create the dissolved gas compensation depth (Section XII.A), the Action Agencies will provide an additional depth of water over mainstem chum salmon redds during periods of spill from Bonneville Dam.

Table VI-1: Migration timing, in the action area, of juvenile Columbia River basin salmonids.			
ESU	**Reach[1]**	**Peak Timing**	**Duration**
SR spring/summer chinook salmon[2]	LGR - BON	April - June	Mar - July
SR fall chinook salmon[2]	LGR - BON	late June - Aug	Mar - Oct
UCR spring chinook salmon[3]	RI - BON	Apr - June	Apr - July
LCR chinook salmon[2]	TDA - BON	Apr -	Apr -
UWR chinook salmon[4]	below BON	Feb - May	Jan - Dec
SR steelhead[2]	LEW - BON	Apr - July	Mar - May
UCR steelhead[3]	RI - BON	Apr - June	Apr - July
MCR steelhead[2]	MCN - BON	Apr - June	Apr - July
LCR steelhead[2,5,6]	below TDA	Apr	Mar - Aug
UWR steelhead[4]	below BON	Apr - June	Jan - Dec
CR chum salmon[7]	below BON	Apr	Mar - May
SR sockeye salmon[8]	LGR-BON	Mar - Sept	Mar - Nov

[1] LGR = Lower Granite Dam; TDA = The Dalles Dam; BON =Bonneville Dam; RI = Rock Island Dam; LEW = Lewiston trap; MCN = McNary Dam

[2] Source: DART homepage at http://www.cqs.washington.edu/dart/dart.html

[3] Source: Juvenile fish trap at Chelan County Public Utility District's Rock Island Dam

[4] Source: Juvenile fish trap at Portland General Electric's Sullivan Plant (Willamette Falls; Table 2 in Cramer and Domina 1998). Note: Observations of juvenile UWR chinook salmon during the fall months are dominated by the release of hatchery steelhead during 1992 through 1996.

[5] Howell et al. (1985)

[6] Myers et al. (1998)

[7] Based on Columbia River temperatures and estimate of cumulative temperature units (TUs) below Bonneville. Assumes 800-900 TUs at emergence, based on "Fish Hatchery Management" (USFWS) and work with Puget Sound chum (900 TUs is the rounded mean of range = 820 to 920 TUs; table presented at a meeting of the regional fish and wildlife managers on July 1, 1999; WDFW).

[8] Source: Fish Passage Center data from LGR, reported in USFWS (1998). Note: Index counts for juvenile sockeye trapped at Rock Island Dam show that Upper Columbia River sockeye salmon move through the lower Columbia River during mid-April through mid-July (USFWS 1998). The more protracted outmigration in the lower Snake River may reflect differences in the run timing of wild residuals or of kokanee washing out of upstream reservoirs.

Table VI-2. Results of the 50-yr HydSim continuous hydroregulation study of the effect of three alternative flow augmentation programs for the Ives Island area on the probability of refilling Grand Coulee to upper rule curve by April 15.

Study[1]	**# Years**	**% Years**	**Avg. Miss (ksfd)**	**Avg. Miss (ft)**	**50-Yr Avg. GCL Elev.**
Option 1: 125 kcfs[2]	40	80%	951	16	1237
Option 2: 125/145/135 kcfs[3]	39	78%	1507	47	1232
Option 3: 125/160/150 kcfs[4]	32	64%	1324	41	1227

[1] All options:

- Storage reservoirs at expected elevations levels on the model start date (October 15)
- Requirement to provide minimum flows of 65 or 70 kcfs at Vernita Bar from December through May;
- Provisional draft at Grand Coulee as low as 1275' in December to manage deficits and/or surpluses during December and January;
- Provisional draft at Arrow of 400 ksfd (200 ksfd in October plus 200 ksfd in November, returned during January);
- Store 1 MAF (500 ksfd) in Arrow for flow augmentation in years with <90 MAF runoff at The Dalles during the January through July period;
- Whitefish operation at Arrow during January through March;
- Trout spawning operation at Arrow during April through June;
- Non-Treaty storage releases from Canadian reservoirs of 10 kcfs during October through November, 7 kcfs during December, and 4 kcfs during January through April (each includes the 100% BC Hydro match);
- Grand Coulee is not drafted below 1283' before November 15th; and
- Grand Coulee is not draft below 1265' during December.

[2] Option 1: minimum instantaneous discharge of 125 kcfs during October 15 through April 15.

[3] Option 2: minimum instantaneous Bonneville discharges of 125 kcfs during October 15 through November 14; 145 kcfs during November 15 through December 31; and 135 kcfs during January 1 through April 10 (incubation and emergence).

[4] Option 3: minimum instantaneous Bonneville discharges of 125 kcfs during October 15 through November 14; 160 kcfs during November 15 through December 31; and 150 kcfs during January 1 through April 10.

Table VI-3. Results of the 60-yr HydSim reservoir-refill hydroregulation study of the effect of three alternative flow augmentation programs for the Ives Island area on the probability of refilling Grand Coulee to upper rule curve by April 15.

Study[1]	# Years	% Years	Avg Miss (ksfd)	Avg Miss (ft)	60-Yr Avg GCL Elev.
Option 1: 125 kcfs[2]	50 (50)[3]	83% (83%)	1430 (1101)	43 (31)	1249 (1251)
Option 2: 125/145/135 kcfs[4]	46 (48)	77% (80%)	1650 (1705)	51 (52)	1251 (1253)
Option 3: 125/140/150/160/150 kcfs[5]	41 (42)	68% (70%)	1492 (1357)	46 (41)	1252 (1244)

[1] All options: draft limits at Grand Coulee Dam of 1283' on November 15; 1270' on November 30; and 1265' on December 31; and a Vernita Bar flow requirement of 65 kcfs during December through May.

[2] Option 1: minimum instantaneous discharge of 125 kcfs during October 15 through April 10.

[3] Result with (without) cold snap power draft (up to 25') from Grand Coulee during December and January.

[4] Option 2: minimum instantaneous Bonneville discharges of 125 kcfs during October 15 through November 14; 145 kcfs during November 15 through December 31; and 135 kcfs during January 1 through April 10 (incubation and emergence).

[5] Option 3: minimum instantaneous Bonneville discharges of 125 kcfs during October 15 through October 31; 140 kcfs during November 1 through November 15; 150 during November 15 through November 30; 160 during December 1 through 31; and 150 kcfs during January 1 through April 10.

Table VI-4. Comparison of life-history types among listed Columbia River basin salmonid ESUs.

ESU	Juvenile Rearing Strategy
SR spring/summer chinook salmon[1]	stream-type
SR fall chinook salmon[1]	ocean-type
UCR spring chinook salmon[1]	stream-type
LCR chinook salmon[2]	predominately ocean-type some stream-type (but may be biased by hatchery releases)
UWR chinook salmon[2]	predominately ocean-type some stream-type (but may be biased by hatchery releases)
SR steelhead[3]	stream-type
UCR steelhead[3]	stream-type
MCR steelhead[3]	predominately stream-type ocean-type in Fifteenmile Creek
LCR steelhead[3]	predominately ocean-type stream-type in Washougal, Lewis, and Kalama rivers
UWR steelhead[3]	ocean-type
CR chum salmon[4]	ocean-type
SR sockeye salmon[1]	lake-type

[1] USFWS (1998)
[2] Myers et al. (1998)
[3] Busby et al (1997)
[4] Johnson et al. (1997)

Table VI-5. Migration timing, in the action area, for adult Columbia River basin salmonids.

ESU	Freshwater Entry	Spawning
SR spring/summer chinook salmon[1,2]	Mar - July	July - Oct
SR fall chinook salmon[1,2]	Aug - Oct	Oct - Dec
UCR spring chinook salmon[2]	Mar - May	Aug - Sept
LCR chinook salmon – spring[2]	Mar - July	Aug - Oct
– fall[2]	Aug - Oct	Sept - Dec
UWR chinook salmon[2]	Mar - June	Sept - Oct
SR steelhead[3]	June - Mar	Mar - May
UCR steelhead[3]	all year	Mar - July
MCR steelhead[3]	all year	Feb - May
LCR steelhead[3]	all year	Mar - June
UWR steelhead[3]	Mar - July	May - July
CR chum salmon[4]	Oct - Dec	Nov - Jan
SR sockeye salmon[5]	Jun - Aug	Sept - Oct

[1] Waples et al. (1991)
[2] Table 1 in Myers et al. (1997)
[3] Table 3 in Busby et al. (1998)
[4] Table 7d in Johnson et al. (1997)
[5] USFWS (1998)

Table VI-6. Chum salmon counted in the Bonneville Dam adult fish ladders (1989-1998) (source: Excel spreadsheet \chumsbon.xls from G. Johnson, Corps Portland District, with updates from J. Loch, WDFW).

Year	Total Number Chum
1989[1]	16
1990[1]	26
1991[1]	5
1992[2]	39
1993[2]	51
1994[2]	26
1995[2]	30
1996[2]	33
1997[3]	50
1998[4]	195

[1] Only daytime video available for November 1989 through 1991 (8 a.m. - 4 p.m.).

[2] Wild steelhead were target species recorded from nighttime videotapes by WDFW readers. Non-target species (e.g., chum salmon) were not always recorded.

[3] Wild steelhead were again the target species but some non-target species may have been recorded. Data for non-target species were not included in the Corps' Annual Fish Passage reports.

[4] 1998 was the first year that the Corps contracted with the WDFW counting program to read videotapes for all salmonids. Although wild steelhead remained the target species for the video count program, observations of chum salmon, pink salmon, and chinook salmon were also tallied by the video reader. All counts were included in the annual report.